PURCHASING PRODUCTIVITY MEASUREMENT SYSTEMS

Dennis Lloyd Wright
Patrick William Cummings

NAVAL POSTGRADUATE SCHOOL
Monterey, California

THESIS

PURCHASING PRODUCTIVITY MEASUREMENT SYSTEMS

by

Dennis Lloyd Wright

and

Patrick William Cummings

September, 1980

Thesis Advisor: D. V. Lamm

Approved for public release; distribution unlimited

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) PURCHASING PRODUCTIVITY MEASUREMENT SYSTEMS		5. TYPE OF REPORT & PERIOD COVERED Master's Thesis; (September, 1980) 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Dennis L. Wright and Patrick W. Cummings		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Naval Postgraduate School Monterey, California 93940		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS Naval Postgraduate School Monterey, California 93940		12. REPORT DATE September, 1980 13. NUMBER OF PAGES 107
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office) Naval Postgraduate School Monterey, California 93940		15. SECURITY CLASS. (of this report) Unclassified 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Productivity Measurement, Work Measurement, Productivity, Management Information Systems, Manpower Utilization, Resources Management, Purchasing, Purchasing Productivity.

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The research focused on the measurement of productivity in purchasing organizations, in both the public and private sectors. The research was conducted by a review of the current literature, field research and survey of key purchasing personnel. The purpose of the research was to develop an effective method of measuring the productivity of a purchasing organization. The results of this research indicate that purchasing productivity measurement systems serve a variety of management needs: control of purchase organizations, projecting and distributing personnel resource needs, preparation of

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 68 IS OBSOLETE
S/N 0102-014-6601 |

Block 20 (cont.)

budgets and the improvement of productivity. The major contribution of the study is the identification of the essential parameters of an effective productivity measurement system and the development of a purchasing productivity measurement model. The model was then tailored to the needs of a public sector field purchasing activity.

Approved for public release; distribution unlimited

Purchasing Productivity Measurement Systems

by

Dennis Lloyd Wright
Lieutenant Commander, Supply Corps, United States Navy
B.S.M.E., University of Nebraska 1972

and

Patrick William Cummings
Lieutenant, Supply Corps, United States Navy
B.S., Villanova University 1972

Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN MANAGEMENT

from the

NAVAL POSTGRADUATE SCHOOL
September 1980

ABSTRACT

The research focused on the measurement of productivity in purchasing organizations, in both the public and private sectors. The research was conducted by a review of the current literature, field research and survey of key purchasing personnel. The purpose of the research was to develop an effective method of measuring the productivity of a purchasing organization. The results of this research indicate that purchasing productivity measurement systems serve a variety of management needs: control of purchase organizations, projecting and distributing personnel resource needs, preparation of budgets and the improvement of productivity. The major contribution of the study is the identification of the essential parameters of an effective productivity measurement system and the development of a purchasing productivity measurement model. The model was then tailored to the needs of a public sector field purchasing activity.

TABLE OF CONTENTS

I. INTRODUCTION

A. GENERAL

> Our nation today faces problems that are unprecedented in this generation. ...At the heart of our problems is the need to improve productivity.
>
> Gerald R. Ford
> January 14, 1975

Productivity growth is the major factor in sustaining the economic health of a nation and in the achievement of national goals, including national defense [37:5]. Productivity growth reduces inflationary pressures, maintains our standard of living and improves international competitiveness.

Traditionally, the United States has assumed that productivity would take care of itself [35:1]. However a renewed interest in productivity growth has arisen as the country battles double digit inflation, rising unemployment and powerful foreign economic forces; while at the same time our own productivity has dropped below historical performance and the performance of all other industrial nations [35:1]. Congressional hearings, establishment of productivity centers and the upcoming presidential elections have made the subject of productivity a national issue [8:3].

The financial resources available to the Government are being squeezed between growing public needs and the cost of meeting those needs. Legislation to balance the budget and Proposition 13-type initiatives in the state of California clearly indicate that a better way to stretch the defense dollar must be found. One such way is to increase individual and organizational productivity.

B. OBJECTIVES

The first thing that must be done to improve productivity is to develop a system of measuring it. This paper will attempt to develop a method of effectively measuring the productivity of purchasing organizations by analyzing the various techniques used throughout the public (Federal, State, Local) and private sector. The primary objective of the research is to develop a generalized purchasing productivity model with broad applications throughout various procurement organizations, recognizing that the actions required to make a purchase are similar regardless of the organization itself. The model should provide the purchasing manager with: (1) the means of objectively assessing the performance of his organization; and (2) provide a method of measuring the performance of individual workers under his control. A further objective of the research is that the model be useful in the distribution and assignment of personnel at individual activities as well as from a central control point (e.g. Headquarters Command and Corporate Headquarters). Finally, the model should be able to be used as a means of forecasting workload requirements.

C. RESEARCH QUESTIONS

In pursuing the objectives, the following research question was posed: What are the critical parameters to be considered in the development of a purchasing productivity model?

In addressing this question, the following subsidiary questions were established:

(1) What are the significant outputs of a purchasing organization?

(2) Can a single purchasing productivity measurement system be applied to all purchasing organizations?

(3) What are the benefits that can be derived from measuring purchasing productivity?

D. RESEARCH METHODOLOGY

Data were obtained from several sources. First, the researchers conducted a review of the existing literature base to gain a basic familiarity and understanding of the prevailing methods of purchasing productivity measurement employed throughout Industry and Government. Excellent information is available from the Defense Logistics Studies Information Exchange (DLSIE) under the search locators of Productivity Measurement, Management Information Systems, Manpower Utilization and Resources Management. Additional literature included: Texts of Congressional Hearings, current Federal directives and instructions and studies prepared by organizations such as Michigan State University, Arthur D. Little and Wayne State University. A more complete list of previous theses, studies and textbooks is contained in the bibliography.

Secondly, field research was conducted by visiting or contacting ten private corporations and 19 Government activities and interviewing more than 40 key purchasing personnel. Special attention was directed towards maintaining a proper balance between Government and the private sector, and between large and small purchasing organizations. Visits were conducted at organizations with as few as

five buyers and as many as 400 to get a better understanding of the methods and needs of a wide spectrum of activities. In the private sector, no single Industry dominated the sample. Firms from the aerospace, electronics, shipbuilding, petroleum, pharmaceutical and chemical Industries were included in the survey.

In the public sector, a representative mix of various activities were selected including: State, local, Department of Defense (DOD) and non-DOD agencies. Within DOD, the Defense Logistics Agency and various eschelons of the three services were contacted. A complete list of personnel and activities contacted is in Appendix D.

A final method of research included a survey of key purchasing, management information system and financial personnel at the selected activities contacted. The survey was conducted to determine the attitudes of management and worker-level personnel towards purchasing productivity. Data for the survey were collected during plant visits or via telephone. To encourage open and frank comments, anonymity was promised. Specific details of the survey are included in Appendix A.

The researchers would like to acknowledge the excellent reception and support given them at each activity visited. Their interest and candor was especially gratifying and added greatly to the validity of this Study.

E. SCOPE OF STUDY

The researchers included as wide a variety of purchasing organizations as possible. Size, goals and degree of sophistication of measurement systems were not factors in sample selection other than the need to maintain a proper balance.

The research is primarily concerned with the pre-award phase rather than post award. However, the researchers know of no reason why the recommendations presented here-in could not be applied to the contract administration phase of purchasing.

Similarly, the acquisition of major systems were also excluded. The researchers felt that the nature of systems acquisition was significantly different from the area of purchasing addressed in this Study.

F. ORGANIZATION OF THE STUDY

The research is divided into seven chapters. In this Chapter, the objectives of the research have been set forth, the scope and direction of the effort identified and methodologies for data collection and analysis presented.

Chapter II provides a historical background in the evolution of productivity measurement in the United States. It gives a perspective of the environment of productivity measurement and serves as an introduction into purchasing productivity measurement.

Chapters III and IV are an examination of the prevalent purchasing productivity measurement systems that were utilized by the 29 organizations contacted by the researchers. Chapter III will deal specifically with the measurement systems utilized by the private sector and Chapter IV will concentrate on the methods Government activities are employing.

Chapter V is an analysis of the significant factors that must be considered in developing the framework of a purchasing productivity measurement system. The strengths and weaknesses of various

measurement techniques as well as problems in implementing a measurement system are analyzed.

Chapter VI presents a model for establishing a purchasing productivity measurement system. The Chapter also demonstrates application of the model to a public sector field purchasing office.

Chapter VII summarizes the results of the research and provides conclusions and recommendations that will assist in the implementation of purchasing performance measurement systems and also improve productivity.

Additionally, the appendices provide information that should be helpful to the reader in any further research in this area.

II. BACKGROUND

A. GENERAL DEFINITIONS

The concept of productivity has been the focus of attention of many leaders in Government and Industry. It has been alleged that "no single issue has more importance to the fundamental underlying economic well being of the United States than productivity" [30:1].

What then is productivity? In general, productivity is the ratio of what is produced to what is required to produce it. The ratio is usually expressed in the form of an average of the total output of some category of goods or services divided by the total input of some resource, such as land, capital or labor. The thrust of the research was directed toward productivity with respect to labor. More specifically, the productivity measure used in this report is the ratio of measured work output to measured work input.

Productivity ratios are traditionally used as general economic and performance indicators and indices such as for measures of growth, efficiency, or work standards. These ratios then provide a means to perform productivity analysis over time or among different productive entities. The emphasis of this study is on productivity in relation to work standards and work measurement and the comparison of similar functions between both Government and Industry as well as within Government and Industry.

Productivity in this sense does not capture the aspect of proficiency, but rather the concept of efficiency. It is important at this point to distinguish between the terms efficiency and proficiency. For the purposes of this report, proficiency is concerned with such factors as effectiveness, quality, expertise and correctness, mastery of a skill or trade and creativity of performance. While these are important considerations and closely interrelated with elements of productivity measurement, they are not considered driving forces in determining the efficiency of the operation or the level of productivity. Efficiency is typically defined as the ratio of effective or useful output to the total input. Although similar in terminology to the earlier definition of productivity, efficiency is more concerned with the effective utilization of resources to produce the output rather than as a means of measurement. Hence, efficiency becomes a critical consideration of productivity and productivity improvement.

B. EVOLUTION OF ATTITUDES TOWARD PRODUCTIVITY

Concern over productivity is not a new issue, its beginning can be traced as early as the Industrial Revolution when machines began

to significantly increase the level of output of man. However, meaningful accumulation of productivity data and a conscious awareness of the level of output per person over time did not begin until 1890 [36:1].

Some of the earliest successes in Productivity Systems and studies are attributed to Frederick W. Taylor and his concept of Scientific Management. Productivity efforts during this period were characterized by extensive time and motion studies of the blue collar worker, concentrating on the instrumental aspects of human behavior. The worker was conceived as an instrument of production with no consideration given to the psychological and sociological interactions. Taylorism, as it became known, provoked resentment and opposition from labor when it was carried to extremes. It was, however, instrumental in rationalizing production and the development of productivity studies. The object of these exercises was to make industry more efficient and thus to increase productivity and profits [4:1].

The workforce, and to some extent management, initially displayed attitudes of apprehension, distrust and fear. Apprehension because it was believed that functions were unique and too variable to quantify; distrust because naive comparisons would be made between workers and work groups; and fear because of the potential ramifications of being under observations of management and the we-they mentality of confrontation between labor and management.

The era of unionism ushered in whole new attitudes toward productivity. Consideration had to be given to employee rights, working conditions and the number of hours worked; each factor influencing attitudes toward productivity. The progressive firm today works to

strengthen worker awareness of productivity by addressing these factors and obstacles. Attention is now directed at job rotation, education and training, work environment, employee involvement in the manufacturing process, resources to develop outside interests and an opportunity to share in the firm's success.

Productivity increases were not only viewed as a problem for management but also a concern of progressive labor movements. As early as the 1920's, joint labor-management committees were established with the idea that workers could make a positive contribution to efficiency in production and that it was in their best interest to do so [29:40]. Most notable of these efforts was the Scanlon Plan, attributed to Joseph N. Scanlon who in the late 1930's realized the need for joint labor-management productivity ventures to remain competitive and hence protect working people and their jobs. Characteristic of his plan were direct financial incentives for employees to perform efficiently and hence productively, and to make cost saving suggestions [29:74].

Since 1960, a wave of social consciousness for individual safety and environmental concerns swept the country. In its wake, Congress created 26 new regulatory agencies to deal with cleaning up the environment and ensuring a safe workplace [30:26]. This resulted in a number of significant new regulations and obstacles that impeded productivity growth. Characteristic of this period were Occupational Safety and Health Act (OSHA) regulations, Environmental Protection Agency (EPA) initiatives, and public visibility of manufacturing processes; each in its own way changing the input-output processes and attitudes toward productivity.

The issue of productivity on an international level has become more critical as the degree of international competition has increased. Comparison of productivity changes in the United States with those in other countries is difficult because of gaps and incomparabilities in statistics. However, it is clear that since 1950 the rate of productivity in foreign countries grew much faster than in the United States. For example, productivity in Japan grew four times faster, while Italy, France and Germany grew two and a half times faster. The United States still out produces these countries; however, at these rates, French and German competitors will be out producing the United States by 1985 [30:2].

By 1970, the evolution of the productivity issue had come into full swing. The impact of rising inflation, declining National rate of productivity, and economic forces created a keen sense of National awareness. In 1970, Congress established a Federal Productivity Commission and one year later, in the Economic Stabilization Act Amendment of 1971, established the first National Productivity Policy for the United States [36:1]. The Commission died in 1974; however, Congressional interest continued through the evolution of several successor commissions until the establishment of the present National Productivity Council in October, 1978.

Traditionally, work measurement and the concept of productivity were confined to blue collar workers and highly repetitive manufacturing processes. However, due to the advancement and use of technology, numerically controlled equipment and computers, the number of personnel in the blue collar workforce has been declining. Consequently, there has been increased concern over the ever-increasing white collar

workforce and the lack of productivity measurement in that sector and its effect on National productivity. This concern has been manifested in initiatives to measure the productivity of the white collar functions. The white collar ranks have confronted this issue with similar attitudes displayed in the early stages of productivity measurement development of the blue collar workforce.

C. FACTORS AFFECTING PRODUCTIVITY

The level of productivity is determined by a number of contributing factors. These include education and skills of the labor force, the level of technology and degree of automation, the extent of capital investment, the resourcefulness and enterprise of managers and workers, perceptions of the workforce, tenure of key personnel, as well as a wide range of social, psychological and cultural factors.

These factors all interact in determining a level of productivity. When a productivity ratio changes due to a change in one factor, a tacit assumption is made that the change in the ratio is solely attributable to that factor. However, it typically is the result of the interaction and interrelationships of all the factors that contribute to that change [35:vi]. The degree of change varies from industry to industry or organization to organization depending on which factor is changed and the magnitude of that change. Changes in a combination of factors further amplify the problem of isolating and evaluating the factor having the greatest effect on productivity.

A major problem in the use of productivity ratios or indices stems from modifications in the baselines or definitions of the inputs and outputs or the input-output process. This tends to frustrate the

development of productivity indices and trend analysis since it is normally impossible to discount the change to a base period or base organization productivity index. Since the system must operate in a dynamic environment, it is essential that the system be designed to incorporate or account for change and that intentional changes to a productivity measurement be kept to a minimum.

D. PRODUCTIVITY INITIATIVES, PROGRAMS AND POLICIES

As early as 1900, the Army's Rock Island Arsenal and the Navy's shipyards at Boston and Mare Island were employing early work measurement systems based on Taylor's scientific management approach [14:34]. The approach was representative of the initiatives experienced in Industry. During the period between 1916 and 1949, DOD efforts in work measurement stagnated with no significant improvements despite developments of modern management-engineering practices conducted in the private sector [3:39]. Typical of such industry efforts were the formation of joint labor-management committees, the Scanlon Plan and the advancement and refinement of time and motion studies.

By 1949, the Government realized the advancements made in Industry, and directed by Executive Order that all Government activities, especially industrial activities, pursue some form of work measurement [25:17].

The current DOD programs began in 1965 with the Warehouse Gross Performance Measurement System and the Defense Integrated Management Engineering System (DIMES) which were established as a coordinated DOD-wide program to get more involved in work measurement. Again, the main emphasis was directed toward Government industrial

type activities [14:34]. The scope was expanded later in 1970 to include more selected non-industrial activities.

The private sector, for the most part, continued on a disjointed effort with each Industry and firm pursuing productivity programs that fit their own organization; however, there was a remarkable common underlying similarity directly related to the philosophies of the day. One such recent occurrence in Industry in the U.S. is the Quality Circles (QC) Program which had its inception in Japan about 18 years ago [11:307]. It is a program designed to more fully utilize the talents and expertise of all employees at all levels, working together in voluntary groups (i.e., circles) to solve their own work related problems. More will be said about the QC program and how it relates to purchasing productivity initiatives in Chapter III.

Another movement that gained momentum and interest in both Government and Industry was to couple an incentives award program to employees who exceed normal performance expectations. In one case, at a West coast Navy shipyard, data transcribers were incentivized to increase their output with a projected annual cost savings of $920,000 [29:62].

On the National level, there has been a significant amount of Congressional interest. Congress established the first National productivity policy in 1971 and has conducted several hearings on the Quality of Work Life and Productivity, the most recent concluded 6 June, 1979. The National Productivity Council was established in October, 1978 to improve coordination of Federal programs designed to improve productivity in both the public and private sectors. Congress has further

acted to promote a more productive atmosphere through more stimulating tax legislation and deregulation of industry, such as deregulation of the airline industry, and more recently, the trucking industry. In 1978, tax legislation which reduced corporate tax rates and liberalized investment tax credits promised to be a small step toward increasing savings and investment in labor saving devices.

New Government programs and policies and industry initiatives seeking ways to stimulate growth will occur as long as the rate of productivity declines and National interest remains high. Much of this effort will be directed at the white collar workforce, traditionally free of work measurement. One such element in this sector is the purchasing function. The next section will summarize purchasing productivity measurement movement in both the public and private sector.

E. PURCHASING PRODUCTIVITY MEASUREMENT

Purchasing is one of the basic functions common to all types of organizations and may comprise a large segment of an activity's white collar workforce. Purchasing organizations in both the public and private sector vary in size from small offices with one or two buyers to large complex organizations with as many as 400 personnel. For the purpose of this report, a purchasing organization was defined as any work group tasked with the responsibility to buy required equipment, materials and services. As stated in Chapter I, the post award or contract administration phase was excluded from the research as well as major system acquisition such as new ship construction.

Productivity measurement in purchase organizations has reluctantly been accepted, similar to the reception productivity measurement received

in other white collar positions. In general, implementation is just beginning and is usually dependent on the aggressiveness and innovation of management or organizational objectives. The efforts that do exist have suffered from a lack of coordination and resulted in disjointed productivity measurement systems being established in both Industry and Government. The hypothesis of this research was that a common fabric exists and once identified could standardize the approach that a given organization could pursue to develop a work measurement system. Common allegations encountered, however, were that: (1) purchasing functions are too unique to quantify; (2) comparisons between purchasing organizations are not valid; and (3) each purchase action is independent of the next. These perceptions will be discussed in more detail in Chapters III and IV.

The public sector, driven primarily by Congressional and Executive initiatives, pursued productivity measurement on a department-by-department basis [26:12]. Within a given department, each agency frequently pursued independent methods of productivity measurement. For example, in DOD, each service employs a different purchasing measurement system varying in the degree of sophistication, application and usefulness to the organization. There is no general trend or common approach that is evident in the public sector.

The researchers observed that the private sector has also made similar efforts into the area of productivity measurement of purchasing organizations. In almost every industry and firm, some form of purchasing work measurement is performed, although the smaller organizations more typically believe that management by "gut feel" is more conducive

to their organization than an elaborate work measurement system. As in the public sector, no dominant method of measurement exists. It is evident that there is a management commitment in Government and Industry toward establishing a meaningful productivity measurement system.

There have been some notable differences between public and private sector approaches. It appears that these differences are driven by differing organizational needs. One such dissimilarity is the public sector's greater reliance on the computer to gather, accumulate, store and disseminate productivity data. A driving factor may be attributed to the public sector's reliance on public funds which mandates the efficient utilization and allocation of resources within Government organizations and hence dictates the need for a comprehensive productivity measurement system.

Productivity measurement systems in the private sector appear to be more concerned with employing a simple yet viable system to provide performance indicators to management for internal use. Computerized and detailed comparative analysis of purchasing divisions at the corporate level is not a major concern in the same sense as it is in Federal purchasing activities. The concern in the private sector, instead, is manifested in another form called the profit motive. The profit motive places more emphasis on the contribution to profit a purchase division makes and hence places different demands on a productivity measurement system, usually more in the form of proficiency or performance measurement.

In both the public and private sector, management resources are being directed at achieving viable work measurement programs in purchase

organizations. Regardless of the driving need, both are seeking some form of measuring the work output and work input. Specific programs and initiatives of the private sector will be discussed in Chapter III, while Chapter IV will outline approaches used in the public sector.

F. SUMMARY

This Chapter has described the evolution of productivity and productivity measurement in the United States. It has defined some of the concepts of productivity and productivity measurement and detailed attitudes that presently influence and will continue to influence future productivity measurement initiatives. Finally, the area of purchasing productivity and its measurement were introduced. The environment of both the public and private purchasing organizations were described, addressing some of the basic concerns of both sectors. The following two chapters will describe the purchasing productivity measurement methodologies that the researchers observed employed at the Industry and Government activities contacted.

III. PRIVATE SECTOR PURCHASING PRODUCTIVITY SYSTEMS

A. PRODUCTIVITY ENVIRONMENT

Business concerns in the private sector are faced with a variety of goals and objectives such as producing a quality product, maintaining a market share and choosing among various financial alternatives. However, one underlying principle permeates throughout the private sector: the need to generate a profit. In order to continually operate profitably, private industry must insure optimum utilization of plant, equipment and personnel. As previously noted, U.S. industry is presently suffering

from a depressed rate of growth and declining productivity. Low productivity rates are, in turn, transformed into lower profits; and in some cases little or no profit, threatening the very existence of industry. As productivity declines, the ability of private business to produce goods and services and to compete in the marketplace also declines. Recognizing that improvements in productivity must be made to reverse this trend, private industry has sponsored the establishment of organizations such as the American Quality of Working Life and the American Productivity Center. The goal of these organizations is to improve productivity through increased awareness, establishment of company productivity programs and exchange of information and techniques between companies. This increased awareness in productivity has resulted in an increased interest in productivity measurement. As a result, productivity measurement systems are being implemented throughout industry at an increasing rate.

The need to apply a measurement system to purchasing organizations is also evident. Over 60% of every manufacturing dollar is spent by purchase divisions [10:7]. Each dollar saved through efficiency in a purchasing organization is an added dollar on the balance sheet of a business, and like all other departments, there is a need for management to determine how the purchase division is contributing to the profit margin of a business. Most private business concerns, especially those with sizable purchase organizations, are now using some sort of measurement system, either formal or informal, consciously or subconsciously, in the evaluation of their respective purchase divisions. The purchasing measurement systems in use are not extracted from textbook models but

rather were arrived at after many unsuccessful attempts to establish standards, measure productivity and project personnel needs. The systems vary widely in degree of sophistication, technique and utilization by management. In spite of dissimilarities, the better systems did have certain common characteristics. First, they were tailored to meet the individual needs of a purchasing organization and secondly, they were implemented with the goal of increasing productivity and assisting management in controlling purchase operations. The remainder of this Chapter will describe the various measurement techniques observed and the more significant features identified for inclusion in the development of a generalized purchasing productivity measurement system.

B. SMALL PURCHASE ORGANIZATIONS

A number of private sector businesses which have small purchase organizations were contacted during the course of the study. The researchers arbitrarily classified a purchase organization with less than ten buyers as small. Typically this entire organization was composed of less than 35 people with the number of buyers ranging from five to nine.

No formal system of measuring productivity existed at any of the small purchase sites contacted. This was true even though other departments of the same organization were utilizing measurement techniques that were quite detailed and sophisticated. The managers of the purchase organizations generally felt that maintaining efficiency data on purchasing personnel was not worth the effort of accumulating it. Only one of the purchasing managers contacted felt that purchasing performance statistics would be of some use, and then, only to assist in justifying his staffing levels. All agreed, however, that even if standards were

available, it would not have a discernable effect on the way they managed their divisions. One site had the data available through its management information system for tracking purchase orders, but did not use the data to determine buyer efficiency.

Several explanations were offered for the apparent lack of interest in the utility of a purchasing productivity measurement system. First, most managers felt that they had a "gut feel" for how productive a work group should be and relied on their own instincts and experience to determine acceptable performance. As good managers, they felt that it was their duty to know the capabilities of the individual buyers. Additionally, the composition of the work force mitigated the need for developing structured efficiency standards. As a group, they possessed a great deal of experience and were thoroughly familiar with the commodities they were buying. Most had been with their respective companies for an extended period of time and were considered valued employees. The managers felt that the buyers knew their jobs and were generally satisfied with their performance. They did not feel that standards would enhance their performance in any way. Further, most small purchase organizations are not, or at least perceive that they are not, staffed adequately to gather the necessary data to develop and maintain a productivity measurement system. This was cited by the small purchasing manager as the primary reason for their reluctance to implement a purchasing productivity measurement system and illustrates the need to keep any measurement system as simple as possible. Finally, the purchase departments tended to remain fairly stable from year to year and not affected by changes in business volume. There was seldom the

need to shift personnel assets from one division to another or to increas or reduce the workforce with any regularity. Also, the purchasing manager rarely was required to provide a detailed justification of the size of the purchasing staff. Growth was accomplished through an incremental process based on the volume of work and how well the purchase manager defended his "gut feel". Reductions usually occurred through attrition or voluntary departure.

The small purchase organizations were primarily concerned, not so much with the efficiency aspects of performance, but with proficiency measures such as cost reductions in purchases, the development of new sources, locating substitute materials and value analysis. The performance of buyers was evaluated on the amount of dollars saved and not on the amount of dollars obligated or the number of purchase orders awarded.

The managers also stated that they were not convinced that productivity standards could accurately measure the performance of a buying group due to the complexities and uniqueness of each purchase. There were simply too many variables to consider. Yet, in spite of their doubts, the managers had developed their own expectations of buyer performance based on statistical data and personal experience and stated that similar performance could be expected of buyers in other purchase organizations. One interviewee, experienced in small purchasing management, indicated that, with minor modifications, he was able to apply the informal standards developed at a previous position to his current purchasing management job with remarkable success.

C. LARGE PURCHASE ORGANIZATIONS

Large purchase organizations not only experience a magnified version of those problems faced by a small purchase organization, but must also

deal with problems that are unique to their own environment. The increased size of the organization and scope of responsibilities requires that additional planning, coordination and supervision be implemented to efficiently control the purchase operations. To assist in the overall management of a large purchase organization, the researchers found that many companies have attempted to implement some sort of purchasing productivity measurement system. At the various sites contacted, a number of attempts, not all successful, had been made to develop a system to meet the many needs of the individual businesses. Since a large number of sites were contacted during the course of this study, only selected sites will be described in order to illustrate specific characteristics typical of purchasing performance measurement systems. The main characteristics of all the sites contacted will be discussed at the end of this chapter.

1. Company A

Company A explained that it had attempted to develop standards through the use of time and motion studies, weighting techniques and computer analysis. Several separate attempts were made at implementing measurement systems, each coinciding with a change in management structure and each with its own approach to the best method to be employed. The frustration of not being able to develop a useful system has resulted in the company abandoning its efforts in this area and management has become very skeptical of any new excursions into purchasing productivity measurement. This frustration and skepticism has not deterred the lower level managers from establishing their own

informal standards to monitor productivity and control their own operation. The only productive measure presently used by general management is that the number of purchasing personnel required is a function of the dollars obligated and the number of purchase orders placed. If the amount of dollars to be obligated and the number of orders to be placed is projected to be larger than the previous year, then additional purchasing personnel will be required. This information is used as an input for the preparation of the annual budget. The management of the purchase division is generally satisfied with not having a measurement system and has no plans to implement a system of any great detail.

2. Company B

Company B also did not utilize formal standards. Data on the average output of the buyers was collected through the company's management information system and made available on a regular basis. This information was not used by purchasing's top management, who considered it meaningless. Consequently, no efforts were made to compare the performance of individual buyers or groups of buyers to a standard level. Similarly, no trend analysis was performed to evaluate the progress of a division from one period to another. An examination of the purchasing data from the previous three years revealed that the performance of the buyers as a group varied very little from year to year and that specific standards might have easily been adapted throughout the purchasing division. It was observed that the second level supervisors did manually maintain statistical data for their work groups to monitor performance and adjust workloads. In

spite of the fact that the top managers felt that the statistics were meaningless, they did use the data to help justify the amount of the overhead budget allocated to purchasing.

3. Company C

Company C had the following goals in mind when they implemented their present measurement system: (1) establish base level standards of performance from which improvements and productivity goals can be measured; (2) improve productivity; and (3) establish a control mechanism to assist management in allocating resources and developing internal budgets. Previous attempts by the company to establish standards were thought to be unsuccessful because they did not accurately measure the actual work being performed by the various divisions. The work units were often too broad and did not consider the variations that occur in different divisions. Secondly, the standards were considered unrealistic and were consequently ignored by the workers and of little use to the managers. To avoid this situation from recurring, the purchasing managers had each division determine what output was significant and should be measured. Each division defined its own tasks including output unique to itself. The output was also weighted according to the complexity or manhours required to produce it. This had the effect of further tailoring the system to each individual division. Standards of performance were derived from bilateral agreements or negotiations between the workers and their supervisors. The standards finally agreed upon were remarkably close to the historical performance of the respective divisions. If the character of the

work changed, then the output was redefined, new weights assigned and new standards negotiated.

The managers utilized the system by comparing the actual weighted output to the agreed upon standard. By monitoring backlog and significant variations from the standards, management could pinpoint problems and when required, provide additional resources. A major feature of the system was the establishment of productivity improvement goals. The goals were developed in much the same manner as the standards were developed: mutual agreements between management and workers highlighting unique features of each division. The purchase managers were reluctant to use the standards as the sole factor in determining staffing levels. Although the standards could be used to make projections of required personnel and would result in justifying additional purchasing personnel in times of increasing workload; there was concern that during slack periods, unwarranted reductions would take place.

The company felt that there were several strong features in the system. First, by involving both the workers and supervisors in the development of the measurement system, credibility of the standards is established. By establishing credibility, the chances of acceptance and success of the system are greatly increased. Secondly, attention is directed towards improving productivity, not just measuring it, through the establishment of mutually agreed upon goals. Finally, although management did not rely on the system to make staffing decisions, it did provide added control and visibility to the purchasing process.

4. Company D

Company D found itself faced with a purchasing environment that included an increased volume of purchases, continuous overtime and little evidence that there would be significant improvement in the situation. To cope with the situation, the company implemented a system that combined a mix of the personal and quantitative approach. Personal, because it involved participation at all levels of the organization. This form of participatory management concept, called Quality Circles, centered on the total involvement of all employees in improving productivity. The intent is to fully utilize the talents and expertise of all employees by involving them directly in problem solving. The workers are assigned to specific problem areas and are tasked with providing specific solutions. The system also has a quantitative aspect as it maintains a continuous tracking of the average buyer performance in a purchase group. The information is not used to establish standards but to determine the present productivity level of the buyers and to monitor the effect of the actions taken as a result of the worker/management cooperative effort. An additional factor included in the system is the computation of a complexity factor. The complexity factor is based on the assumption that the higher the dollar value of the individual purchase, the more difficult it is to complete. The complexity factor is used to explain variances in the performance of the buyers.

Some examples of the successes of the system include a sizable reduction in the workforce and a reduction in the number of contracts requiring changes. Internal procedures and management structure were modified as a result of worker suggestions, saving large amounts of man-hours and improving productivity.

The strengths of the system are that all efforts are directed towards improving productivity. The employees support the application of the measurement system because they participate in the problem solving process and are provided feedback on the success of their efforts. Management is able to monitor progress in the various buying groups and can assign additional personnel or management attention where needed. No attempts have been made to utilize the system for projecting staffing levels.

Several other sites were contacted during the course of the study. The systems employed were similar to the systems in use at companies C and D. They were characterized by group participation in the development of the system, assignment of weighting or complexity factors, and the establishment of formal or informal standards to compare actual hours to earned hours (the number of hours a task or worker should accumulate under standard or average times) in order to determine productivity. The systems were also used to highlight trouble areas and allow management to shift resources where required.

The researchers observed features that were common to all of the systems presently in use. For example, seldom were attempts made to compare one purchase division to another, or one company to another company. Since each system had different standards and allowed for variations in each division, there was little to be gained by making comparisons. Similarly, the standards were not used to discipline or fire any workers for not performing up to the established standards. In fact, most managers were expressly forbidden from using the standards to discipline individual buyers. As noted earlier, the

standards were never used as the sole factor in determining the number of purchasing personnel required. The degree to which most managers relied on the established standards for projecting staffing levels was generally very low.

Another common feature, contrary to that reported in another study [12], was the use of manually computed productivity data instead of reliance on computer analysis. Management preferred to keep their systems simple and understandable to all workers and felt that an automated system would be unnecessarily complex and not particularly cost effective. However, computer based data was used to provide some information to the purchasing manager, who in turn manually computed the productivity index of a given division.

D. SUMMARY

This Chapter examined the purchasing productivity measurement systems observed being utilized in the private sector. Numerous methods were in use varying in sophistication and intended use by management.

Those companies with small purchase divisions were primarily concerned with buying proficiency, such as dollars saved and new sources, not buying efficiency. No formal standards were employed by the small purchase organizations contacted.

Large purchase organizations have made various attempts to implement purchasing standards. Some have abandoned their efforts after several attempts, while others have continued to experiment. Those companies with purchasing productivity measurement systems have established standards with the intention of gauging present performance and improving productivity.

IV. PUBLIC SECTOR PURCHASING PRODUCTIVITY SYSTEMS

A. PRODUCTIVITY ENVIRONMENT

Until 1970, productivity measurement in the public sector was largely ignored, unmeasured and excluded from National productivity indices. Yet public employment at all levels employed about one-sixth of the American workforce [29:67]. Exclusion of Government productivity from National productivity levels becomes significantly important as the degree of Government services expand, level of Government employment increases, and the size of Government budgets decrease.

Decreasing Government budgets and increasing public awareness of Government processes, such as the Proposition 13 initiative in California, make it essential that Government activities obtain the greatest degree of output possible within existing resources. Productivity measurement systems can be used to enhance the public sector's output, assist Governments to become more efficient and monitor the utilization of resources [26:6].

The researchers have found that measures of productivity in public sector purchasing organizations can be classified into two categories: (1) systems designed to assist in resource management and budget formulation; and (2) systems designed as a management tool which track general overall performance. The first type of system typifies those efforts in the DOD while the second is more characteristic of non-DOD Federal agencies and state and local Governments.

Within the public sector, the DOD is the forerunner in purchasing productivity measurement systems. Most of the DOD efforts, however,

have been pursued independently by each agency within DOD. This multi-directional approach has served to provide an excellent basis for productivity research and purchasing productivity analysis.

There are several reasons for the greater degree of emphasis on productivity measurement systems in the DOD and especially in the purchase organizations: (1) the concentration of large numbers of contracting personnel doing similar functions under uniform regulations is conducive to productivity studies and the establishment of work standards; (2) local and state purchasing offices are frequently too small to permit extensive involvement with productivity systems; and (3) DOD agencies answer to a central authority and actively compete for resources that must be justified and defended before Congressional hearings.

Since there are these differences, the distinction between DOD and non-DOD purchasing productivity systems will be continued into the next two sections of this Chapter. The next section will outline some of the more significant purchasing productivity systems the researchers analyzed in the DOD, followed in the second section with an analysis of the programs encountered in the non-DOD sector.

The analysis of public sector purchasing productivity systems in both sections will highlight those salient characteristics, both pro and con, that the researchers consider to be important in establishing a generalized purchasing productivity model.

B. DEPARTMENT OF DEFENSE PURCHASE ORGANIZATIONS

All DOD agencies use some form of a work measurement system in their purchasing organizations. These systems generally represent

a sub-element of a larger overall agency productivity measurement program such as the Defense Integrated Management Engineering System (DIMES). Within an agency, suborganizations or activities frequently employ local informal productivity systems to supplement the agency model which may not satisfy all their own management needs.

The research uncovered many productivity measurement systems, both formal and informal, too numerous to mention. Therefore, only those systems that the researchers perceived to make a meaningful contribution toward measuring efficiency and performance of a purchasing organization will be discussed.

1. Activity A

Activity A within the DOD has implemented a highly sophisticated computerized program to establish and measure productivity standards among the major procurement commands. The system was designed to support three goals: (1) to forecast procurement manpower needs; (2) to provide data on the effectiveness of contracting personnel; and (3) to be of practical use to managers. The driving force and justification behind the development of the system, however, was to establish the capability to determine the number of personnel that would be required to staff a procurement function within the agency.

Twenty-three contract types were identified in three stages of procurement in conjunction with 53 complexity (variable steps) factors to establish a matrix of procurement actions performed in the course of a procurement. Over 4,800 separate engineered standards were developed to support this system to enable the accumulation of earned

hours based on the stage of procurement, the contract type and the variable actions performed.

Actual hours are then compared with the earned hours accumulated to determine a performance efficiency (PE) factor measuring the relative effectiveness of the organization. This PE factor is computed once a month for each level of the organization starting with the lowest work center. Although the capability exists, a PE factor is not determined down to the individual worker level. The PE's are, however, utilized at the headquarters level to compare one activity against another.

The system has met with success within the agency and has been studied by other DOD agencies for potential export. Its strongest feature is the ability to use the system to forecast manpower requirements. This is accomplished by running projected workloads through the matrix and simulating staffing levels. In the same manner the impact of program or policy changes can be measured by changing matrix values and evaluating their effect on resources prior to implementation.

This system recognizes that each purchase action is different through the various complexity factors and the number of contract types employed. However, this same recognition and strong selling point is also the system's biggest deficiency. A system of this magnitude requires extensive automated data processing (ADP) services to monitor performance and to maintain and revise the standards. This may prove burdensome and cost prohibitive for smaller organizations or organizations that must justify a cost benefit analysis of the measurement

system. As one industry representative indicated, a profit oriented firm must first justify the investment in such a productivity measurement system in the terms of actual productivity payoff; a measurement system in itself would not be sufficient to warrant large investments.

A complex system such as this also creates data collection problems, requiring each buyer to fill out forms and check appropriate boxes to accumulate productivity information which is then fed through a computer model. This again may not satisfy the needs of an organization that does not have the resources to comply with a sophisticated reporting mechanism nor desires to add to the already heavy clerical workload levied on contracting personnel.

2. Activity B

While Activity A developed a complex and sophisticated system heavily dependent on the computer, Activity B pursued a more basic approach tied to their budget process measuring the overall effectiveness of the purchasing manager. Work is divided into functional areas and cost accounts such as procurement operations or contract administration. For each cost account, a composite efficiency index is computed from: (1) manpower costs directly attributable to the functional account; (2) actual hours expended in performance of that work; (3) workload in the form of procurement actions and line items completed; and (4) weighting factors that relate current year actions to a base year level. The index is then used to measure the total performance of the manager operating a cost center and the efficiency improvement from the base year.

Comparisons from one organization to another or at higher levels are made after further consolidation; however, they become

increasingly ambiguous and difficult to interpret since measurement is from a base year and output is too generalized. The system does not allow for performance measurement down to the individual worker level.

This ambiguousness and gross level form of measurement results from generalized work units, lack of work standards and failure to consider some form of contract complexity. The system provides only gross staffing requirements and generalized performance measurement from year to year.

It is a relatively simplistic and unsophisticated performance measurement system but does not address the heart of productivity, output and input.

3. Activity C

Activity C developed a work measurement system to satisfy three agency needs (similar to the goals of Activity A): (1) to evaluate labor performance between lower level organizations; (2) to determine staffing levels of field activities; and (3) to allocate resources. The system is based on the development of time standards to perform various functional tasks, such as large solicitations, evaluation and award, and small solicitations.

Each functional task is divided into various sub-elements or steps which are necessary to perform the overall functional definition of the task. The large solicitation functional task is made up of 22 steps or sub-elements, such as making the procurement plan or preparation of the solicitation document. For each element or step within the functional task, a standard time has been developed. These work

element standards are then summarized to form a functional task standard. In this manner, when one element or step within the functional task is changed, it is possible to isolate and re-evaluate a time value for that element without re-establishing the entire functional standard.

The functional standard is tailored to an individual activity by multiplying each element or step substandard by a weighting factor. The weighting factor is based on a frequency of occurrence that the particular step is performed in an organization's procedures. Therefore, it recognizes the contract complexities or organizational differences by permitting a higher frequency of occurrence for one step at one activity while permitting a lower frequency of occurrence at another activity.

In this manner, uniform standards are applied across activities yet tailored to account for variances. Manpower and cost data are then accumulated to establish a relationship between actual man-hours utilized and the man-hours earned on the basis of established standards and signifies the effectiveness of accomplishment for the reporting period. The reports are summarized for each field activity and provide the agency a means to evaluate each activity and also provide to the field activity a means to evaluate internal work center performance.

The system has been acclaimed to be the most effective and useful work measurement system in the DOD. It can be used to justify existing resources, allocate new resources and substantiate budget requests. A recent study into this agency's system support the potential of the system; however, it also noted that it was not being used to its full potential. Senior levels in the agency and the DOD did not staff or budget to the same levels the system would indicate. This

creates doubt at the user levels, since the system indicates one level of staffing, yet the activity is staffed to a different level. This illustrates a key point: if a credible productivity measurement system is employed it should be used; if not, the time and effort tracking productivity may be counter-productive.

Several interviewees consider that the major deficiencies of this system are that the standards are not revised frequently enough, the system is not used in budget submissions even though the data is available, and the system does not measure the output of the individual purchasing personnel. This later function is left to the first level supervisor to monitor individual output and compare to the work center's reported output.

The researchers observed several strong points that should be highlighted. It is a basic approach to work measurement utilizing well-defined functional tasks, work units, and work standards. Even though work element standards are fairly specific, use of a single functional standard comprised of the sub-elements eliminates extensive data requirements since output is applied only against the functional standard. Individual workers are free of the encumbrance of filling out forms or counting output which limits manipulation. Data is collected from existing data base information systems and requires minimal ADP processing time.

4. Activity D

Activity D in the DOD designed their productivity measurement system in conjunction with financial management needs that could be used to manage resources and evaluate field activity performance. It

is based on 18 purchasing functional cost accounts such as large purchase, document control, and contract modifications. Each functional cost account defines a given function, work unit and point of count.

Within each functional cost account, man-hours expended in the performance of that work are accumulated with the number of work units completed. From this data, a productivity rate is developed. These rates are then reviewed annually to establish a standard rate to be used in budget formulation and performance evaluation over the next 12 months. The evaluation is based on an efficiency comparison of actual hours to earned hours calculated from the standard rate and work units completed.

This system is straight forward with simplified data collection and uniform measuring criteria. Reports are available at all levels of management and are well suited for trend analysis.

The researchers observed several major deficiencies associated with this system. First, the definitions of work in the functional cost accounts are too general and permit too much flexibility in hours that are charged or omitted from the cost account. Second, the absence of work measurement standards and the basing of a production rate on historical performance permit inefficiencies to creep into the system. Third, the system does not give any consideration to the complexity of the work; hence, an order against an ordering agreement is given the same weight as a formally negotiated contract. Finally, because of the broad definitions of functions and lack of complexity consideration, comparisons between activities become ambiguous at best.

During research of a field activity within Activity D, the researchers found an interesting local weighting procedure that is

worthy of note. Each large purchase action at this activity is assigned point values for contract functions such as dollar value, type of specification employed, method of cost or price analysis, and degree of negotiation. Each step provides for a range of points to be assigned depending on the degree of complexity for that step. For example, the category for type of specification earns very little points for a catalogued item while a newly written complex performance specification earns maximum points. The total point value for each step is totaled reflecting the overall degree of difficulty. Through this simple concept, the activity recognizes the complexity of a procurement action and is in the position to compare work output based on contract actions falling within the same range of point values.

C. NON-DEPARTMENT OF DEFENSE PURCHASE ORGANIZATIONS

As stated earlier, the non-DOD productivity measurement systems are more oriented toward a management information/tracking system concept than as a true work measurement system. The researchers observed only limited interface with work standards, resource allocation and workload forecasting. Many of these systems are just being developed and are in a much earlier stage of development than their DOD counterparts. These systems, in general, provide management with only limited evaluation of purchasing productivity and are typically less sophisticated and complex than those employed in DOD.

There were no systems which warrant detailed description and analysis. The researchers did not uncover any system beyond gross level output and total organizational manpower level comparisons which

provide only gross level measurement not suited for adaptation to a generalized model. Rather, a narrative analysis of the perceptions and key points will be presented which permeate the attitudes of those purchasing personnel employed in the non-DOD public sector.

The smaller county and state purchasing offices have only limited time and resources to experiment with work measurement studies and initiatives. Formal productivity measurement systems were almost non-existent. Many of these smaller public sector procurement offices relate the same problems encountered in the smaller private sector industry purchasing offices outlined in Chapter III. Instead, they rely on other performance measurement criteria and more intimate management techniques. However, most of these smaller purchasing office supervisors recognized the need for work measurement systems, especially in view of the public interest and being under the "public eye".

One of the small public sector supervisor interviewees related his reason for the need for a productivity measurement system in an office of eight buyers. He felt that some individuals, even in small organizations, can effectively hide their inefficiencies. Frequently, even though poor performance is suspected, corrective action is difficult without productivity back up data.

The larger public sector procurement offices at the Federal, state and larger county level generally recognize the importance of measuring productivity and did so to some extent; but not in the same sense as in the DOD. Where productivity data was being tracked, they were used in only general comparisons. No efforts were made at weighting or developing work standards.

In almost every case, procurement managers realized the importance of recognizing contract complexity in some way. One interviewee related that while his office did track the number of awards per buyer, it was up to management to subjectively incorporate the degree of complexity in the individual's annual performance evaluation. In no case did any system try to quantify or incorporate contract complexity.

In every case but one, no attempt was made to relate resources to contract actions. In the one instance, even though it was recognized that the productivity data were only gross level indicators, they were used as a "best estimate" in budget preparation and reimbursible charges to other departments for services rendered. It was felt that this provided some degree of credibility to the rates charged or budgets projected rather than a level of effort or incremental budgeting.

Many of the productivity measurement systems were in the early stages of development. One large non-DOD Federal agency did not employ any productivity measurement system until one year ago. This activity recognized the deficiency and is in the process of developing a system utilizing existing data base statistics. It is anticipated that this system will measure the output of each buyer and consolidated statistics for various level comparisons based on different contract types awarded. Since the system was not fully developed, it was difficult to assess its merits. However, it did appear that it would incorporate standards for various contract actions, by field activities and provide all managers with a management tool to monitor activity output. It did not appear that this system would be used in the budget process to allocate or adjust resources.

A commonly expressed concern of almost every purchasing manager was that measuring purchasing productivity was not something nice to do, but rather, something we have to do. This concern may be manifested more strongly in the public sector because of the utilization of public funds in the performance of a Government service. There appears to be a mandate to hold officials responsible for efficient utilization of resources. Hence, an ever-increasing need to develop work measurement systems which can monitor resources, allocate resources and justify Government expenditures.

D. SUMMARY

Measuring purchasing productivity in the public sector is driven by the need to justify and monitor resources. Unlike the private sector, it is not driven by the profit motive; however, many of the fundamental principles are similar.

In this Chapter, some of the productivity systems, characteristics and attitudes employed in the public sector were presented. Chapter IV, together with the systems and characteristics discussed in Chapter III, will form the basis for those parameters and factors that the researchers feel are important in the establishment of a productivity system that will be developed in the next Chapter.

V. FRAMEWORK OF A PRODUCTIVITY MODEL

A. INTRODUCTION

A good purchasing performance measurement system can assist management in planning, budgeting, controlling personnel performance

and more importantly, improve productivity. Previous chapters have described various methodologies used by Government and Industry to measure purchasing productivity. Some methods have been unsuccessful because they were poorly conceived and improperly implemented. Others have been quite effective in analyzing performance and are used by management in controlling and budgeting for the purchase operations. This Chapter will discuss the main characteristics of the various methods that led to the success or failure of a particular purchasing performance measurement system. The characteristics discussed are those the researchers consider necessary for inclusion in the development of a purchasing productivity model. The factors will be presented in the same sequence as the model steps in Chapter VI.

B. CHARACTERISTICS OF PURCHASING PRODUCTIVITY MEASUREMENT

The following is a discussion of the main characteristics and features of the systems that the researchers observed at the 29 activities contacted.

1. Management Commitment

A commitment on the part of management to measure purchasing performance and support the implementation of a measurement system appears to be so obvious that it is often overlooked. However, without that commitment, any attempts to measure performance will be ineffective and used only superficially as "window dressing" to satisfy another reporting requirement. This research effort has found that to insure success, all levels of management must emphasize the importance of using work measurement techniques.

As illustrated in previous chapters, if each change in management brings a new approach to performance measurement, or management has assigned a low priority to purchasing performance measurement; then both buyer and supervisor will abandon or ignore any initiatives in this area. Company A in the private sector had implemented a new system with each change in management. The systems were not in effect long enough to gain the benefits of performance measurement. They failed to realize that there is a continual process of refining standards and output until accuracy and validity can be established. Repeatedly scrapping one method and implementing another negates the benefits of a maturing measurement system. Further, it frustrates all involved and lessens the chances of any future system being successful.

A general lack of commitment is also evident from the data gathered in Appendix A, where over 61% of the sites that had purchasing performance measurement systems felt that their systems were ineffective in measuring performance. The management at these sites resorted to other, more subjective, methods to assess performance. On the other hand, those sites that were pleased with the effectiveness of their system enjoyed the full support of top management. The researchers have discovered that if a purchasing productivity measurement system is going to be implemented; then, it must be fully used or not used at all.

2. Determining Needs

The researchers have discovered that before embarking on the implementation of a particular measurement system, an organization

should consider its needs and goals. Several of the systems described in the two preceding chapters, particularly those in the Federal sector, require substantial capital investment and the availability of extensive ADP equipment. Obviously, a system such as that in use at Activity A in the public sector would not be cost effective to most activities. A productivity measurement system should result in savings to an organization, not drain its resources. It was noted in Chapter III that most small purchase organizations had frequent contact with their buyers and felt that they had good control of the efficiency of their operations. Most of the small purchase organizations concentrated their efforts on the qualitative areas such as price effectiveness, vendor performance and development of new sources. In these cases, a system that measured efficiency would add little to the effectiveness of the buying process and these activities could better meet their needs by stressing buyer proficiency.

Large purchase organizations must also be concerned with the expertise of their buying practices; but due to the sheer size of the purchase operations, must be equally concerned with efficiency. Typically, those activities with large purchase operations have implemented or are in the process of implementing a purchasing productivity measurement system.

3. Identify and Define Tasks

Next to a management commitment, proper identification and description of the tasks to be measured was found to be of primary importance. Examples in both the private and public sectors illustrate this need. The following problems associated with the identification

and definition of tasks were observed by the researchers: (1) task definitions were either too broad or too specific, (2) output was not measurable, and (3) the output did not represent the work being performed. One Government activity defined purchasing output in 18 cost accounts. They then required that the various subordinate activities report their output in terms of these accounts. The activities being measured felt that the accounts, as defined, were too broad and provided only gross measures of performance. No consideration was given to account for the differences that exist from one activity to another. Company C in the private sector stated that one of the primary reasons for the failure of previous attempts to measure purchasing productivity was that they were not measuring the actual output of each division.

On the other hand, some task definitions have been too specific and attempted to measure output that was of little or no significance. One Government activity was measuring tasks that, when accumulated, were less than one man-year of work for the entire division.

To cope with these problems, some managers have resorted to two techniques. One of the methods utilized by Company C in the private sector is to involve those that actually produce the output to identify and define those tasks that are a significant part of their work, and that can be measured. Their experience demonstrated that this form of participation led to better identification and definition of actual output. An additional benefit of encouraging worker participation is that there is more support for the system when implemented.

A second method observed in both the public and private sectors is a process of assigning weights to the output. Weighting recognizes

the complexity of completing assorted purchase actions and gives the worker credit for the amount of effort required to produce it. Weighting techniques are attractive because fewer tasks need to be defined. The various steps involved in any purchase action are accounted for in the assignment of a complexity factor. A more detailed discussion of the advantages of weighting will be presented later in this Chapter.

4. Determining Method of Data Collection

An effective method of collecting data is another essential element of a successful purchasing productivity measurement system. The researchers observed several problems that frequently occurred in the collection of performance data. Often the collection of the data becomes a nuisance to those doing the work. Providing the data is an administrative burden where productivity does not rise, but the amount of paperwork does. Several of the sites had their buyers filling out complicated forms that required them to keep track of all of their activities throughout the day. As the complexity of the data collection increases, the amount of time required to complete the reporting requirements also increases, reducing the amount of productive work time.

Another common problem that was observed was that of data manipulation. Chapter IV illustrated the case where the buyers at Activity D, when filling out required reports, divided their time between work units to ensure the best mix of earned hours. Further inaccuracies occurred because the buyers had to make subjective decisions as to how much time was devoted to each work unit. These decisions became more

unreliable depending upon the length of time between when the buyers performed the work and when they recorded it. The best data collection methodologies observed had very little impact on those performing the tasks. By eliminating the worker as much as possible from involvement in the data collection phase of performance measurement, management can minimize the disruption of filling out forms and remove some of the manipulation and subjectivity from the data.

Some activities, especially Federal activities, rely heavily on ADP equipment to gather the data necessary to establish performance standards. However, before implementing a costly computer system, the user must consider the size of the organization, the additional capital investment and the productivity payback that will accrue from such an investment. Consideration should be given to utilizing existing capabilities. Many of the organizations already had management information systems that contained the necessary data for the development of standards and simply had to extract it.

Manually compiled productivity data were also effective in both Companies C and D of the private sector. Company C stated that their manual system was simple, cost effective and sufficient to meet all of their needs.

5. Data Collection and Analysis

After a suitable method of accumulating data has been determined, the task of physically collecting and analyzing the data must be addressed. One flaw that the researchers observed in this phase was that when the output was redefined, data collection methodologies were not modified to accommodate the newly defined work units. Any analysis of the data

based on the old work units is likely to be invalid. It is imperative, therefore, that the analysis be done in terms of the newly defined work units.

The length of time required to collect sufficient information and to analyze it varies from activity to activity. The researchers observed two extremes. Activities which perpetually collect and analyze data, but never promulgate output rates, expected performance levels or standards; and activities which prematurely develop standards based on periods of observation which do not permit a realistic accumulation and analysis of the data. Both extremes tend to cause the supervisors and the workers to lose interest in the implementation of a performance measurement system for two reasons: (1) the development process drags on with no apparent purpose and (2) premature standards or rates quickly lose credibility. Both situations result in a loss of enthusiasm and momentum.

The researchers have found that a period of approximately three months is sufficient to develop preliminary standards or targets. Periods of less than three months do not permit adequate information to be accumulated, while longer periods tend to draw out the process and do not significantly enhance the analysis. The key factor in preliminary data collection and analysis is to establish a workable base-line or starting point. Once the preliminary standards and starting points have been established, an additional three month test and evaluation period is necessary to isolate and refine deficient preliminary standards. After six months, the activity should have a good handle on output levels and work standards.

The analysis aspect actually begins with the planning of the data collection phase. Decisions such as determining the level at which data should be collected (by buyer, work center, or activity) and the periods of reporting, must be made. The next step requires some form of analyzing the data that have been collected and accumulated. The analysis can range from simple trend analysis of actual output per buyer compared against a group norm to sophisticated statistical analysis employing least squares, regression analysis or other form of statistical analysis with levels of variance and standard deviations of acceptable performance. In the case of trend analysis, a standard can be derived from the group average with subjective modifications incorporated based on management experience and the level and make-up of the workforce. This standard can prove to be just as effective as standards derived from computer simulation and analysis using complex statistical computations. In either case the key determinant and level of analysis performed should be dictated by the needs of the organization and the level of expertise available within the activity.

In some situations, analysis also consists of redefining tasks after determining that the task was too broadly defined in the task identification and definition phase. Activity D experienced this same problem in which a work unit was defined as "large purchase" and included any award greater than $10,000 regardless of contracting methodology. This work unit did not recognize the significant differences in the various contract actions that made up the work definition. The analysis phase should identify such a deficiency and indicate a need to redefine the task and subdivide the work unit into several smaller work units.

Other forms of analysis can also be incorporated, such as direct observation of the worker performing the task and measuring the time it takes the worker to perform the task. Consideration should be given to achieving a random mix of tasks such that the measured observed time is actually representative of the functions performed. Here again, the level and degree of analysis (engineered time and motion studies or first level supervisor analysis) should be determined based on the organization's requirements and resources available. Direct observation and evaluation of worker performance of work tasks and subjective management intuition are factors that contribute to analysis of the data and the establishment of standards.

6. Developing Standards

Standards are typically defined as the amount of time it should take a trained worker, or group of workers, to complete a described work unit of an acceptable quality. Standards can be derived from detailed time and motion studies performed by industrial engineers or by management employing less sophisticated and costly methods such as averaging, general observation and knowledge of functions being performed. The type of standard and method of developing the standard should be dictated by the needs of the organization.

Standards are often perceived by those whose performance is assessed by them as a way for management to force them to work harder. Company C in the private sector even avoided using the term, opting instead for the less offensive label of Weighted Work Units (WWU). There are several reasons for the negative connotation. First, standards are frequently unrealistic and bear little relationship to historical

performance. Secondly, there is a tendency, especially in the Federal sector, to apply standards to a broad base of activities regardless of the differences in an organization, its mission, quality of personnel and degree of automation. Activities A, C and D in the Federal sector applied the same purchasing performance standards to all of their subordinate activities. Activity D most notably was experiencing wide fluctuations in performance between the activities under its control. Third, standards have frequently been used incorrectly. Productivity goals, again not always attainable, are often included in the standards. The standard no longer represents actual performance but a plateau for the worker and manager to attain. When goals are arbitrarily included in the standards and are not acknowledged specifically as productivity goals, confusion and frustration often result.

To add credibility to the standards, and also to generate support for the entire system, several sites had developed standards with the assistance of those that perform the tasks. Comparisons with the data previously collected and analyzed should confirm the validity of the proposed standards. Company C in the private sector noted that the standards proposed by the workers were extremely close to the recorded performance. Once agreement has been reached on standards, they should be promulgated and published visibly. One site visited was employing standards to evaluate performance but the buyers were only vaguely aware of what those standards were. Standards, either preliminary or final, require continual monitoring so that adjustments can be made as changes occur in (1) the nature of the work,

(2) contracting methodology, and (3) technology. Many of the sites contacted were gauging performance against outdated standards and were misled concerning performance and productivity improvement in their work groups. Standards are not inflexible, they are continually evolving. Management must constantly re-verify the standards to maintain their validity and credibility.

7. Comparisons

Inevitably, management will want to make comparisons when standards have been developed. Comparisons can be made between individuals in a work group, between divisions in the same activity and between one activity and another.

The researchers found that although most managers felt that comparisons could be made between individual buyers (Appendix A), most were reluctant to actually do it on a formal basis. Several reasons were offered. First, individual comparisons often overlook the difficulty of purchase actions assigned to a buyer and comparisons may be misleading. Secondly, when comparisons are made between individual buyers, those not performing up to standard may be subject to ridicule, harassment or discipline. When the system is used as a disciplinary tool, it will take on a negative connotation and encounter resistance. Finally, although most of the systems observed were capable of making individual comparisons, the primary purpose of the system was not in this area. For example, Activity A in the public sector made no attempt to furnish its first level supervisors with individual buyer performance data even though the system was fully capable of doing so. The primary purpose of the system was to project personnel resources.

Most of the activities felt that comparisons between groups and activities were difficult because of the differences that exist in each organization and the type of material purchased. However, Government activities, due to their very nature have a need to make such comparisons in order to allocate personnel resources and exercise management control over many geographically dispersed activities. In the private sector where each company is organized differently and has developed its own unique standards, comparisons are of limited use. If the standards are developed correctly and tailored to each individual activity, then the only truly meaningful comparison is between actual performance and standard performance.

8. Incentives

When a purchasing performance measurement system is implemented, many managers feel that they will be penalized for better performance by a reduction in personnel or by raising standard performance. Ironically, those with subpar performance are provided additional resources to complete their tasks. This perception of penalties is difficult to overcome because one of the benefits to management of increased efficiency is that fewer inputs are required to produce the same output. Company D in Chapter III illustrates this point. Sizable reductions in the workforce resulted from improved work methods suggested by the workers themselves.

Management must provide incentives to supervisors and workers to ensure that maximum effort is directed towards improving productivity. In the private sector, the managers of efficient operations were rewarded with promotions or bonuses. However, the workers at the sites contacted

were seldom compensated monetarily for superior performance. Rather, their efforts were rewarded with special awards, recognition and additional privileges.

The public sector has initiated isolated instances where monetary compensation is given to buyers for superior performance but no widespread program has yet been established. Clearly, there is room for much improvement in providing those who are productive with a share in the savings obtained through improved efficiency.

9. Weighting

As previously noted in this Chapter, assignments of weights to output can be useful in defining tasks. Weighting considers the complexity and effort required to produce a purchase action and gives the worker more credit for completing more difficult jobs. Purchasing outputs can be defined in larger, easily identified units because the many steps involved in completing a given purchase action are included in the assigned weight.

Weighting is also useful in data collection and development of standards. The data collection phase begins with identifying the meghodology that will be employed in collecting work outputs and labor inputs. Output typically will not create any significant collection problems; however, collecting input hours does. Individuals frequently expend time working on several different work units throughout the day and cannot allocate specific units of time between functions. These workers must keep track of the time expended on each task. Collecting this data would require each individual to (1) keep separate records of the time spent on each function, (2) allocate time between

functions based on memory at the end of the day; or (3) allocate time based on some predetermined ratio such as 50% to one function and 50% to another. None of these methods is acceptable since each adds to the individual's already heavy workload and permits manipulation of input that will distort performance measurement. Therefore an alternative solution is required.

The researchers have found, based on the system employed in Company C, that a system of weighting can alleviate this problem and still permit meaningful measurement of productivity. In this manner, only the total hours expended is required to be reported and data collection can be accomplished through existing payroll accounting systems. To illustrate, assume that a purchase organization subdivides its effort into only two types of actions, small purchase orders and large purchase awards. Further, assume that it takes four times as long to complete a large purchase as it does to complete a small purchase. By assigning a weight of 1.00 to the large purchase and 0.25 to the small purchase, Weighted Work Units (WWU) can be computed by multiplying the number of each type of action by its corresponding weight. If four large purchases and 16 small purchases are completed, then 8.00 WWU's have been earned.

Actual hours worked can then be applied to develop productivity rates and standards. Using the previous example, two workers had the same output: 8.00 WWU's. However, one worker spent eight hours on the job and the other worker only six, taking two hours sick leave. The former worker has a productivity rate of 1.00, while worker number two, with the same output, has a productivity rate of 1.33.

Standards can be developed by applying the WWU of an entire division to the total hours worked by the division.

The only measures that need to be accumulated are designated outputs and the total input hours worked. Subjective distribution, manipulation and detailed recordkeeping of labor input is eliminated.

10. Uses of Systems

A final area to be addressed in this Chapter is how the various activities used their purchasing productivity measurement systems. Ideally, such a system can be used as a management tool for evaluating purchasing performance, shifting resources from one area to another, planning for future needs and assisting in the preparation of budgets. Finally, a purchasing performance measurement system can be used to improve productivity by focusing management attention towards more efficient operations and the establishment of realistic improvement goals.

The sites contacted in the private sector primarily used their systems to determine the efficiency of purchasing managers, shift resources where needed, and improve productivity. Company C established specific productivity goals that were agreed to by both management and the workers. Very few of the sites relied on their systems as the primary source for projecting personnel needs or developing budgets.

The public sector, especially those DOD activities described in Chapter IV, used their systems primarily to compare various subordinate commands and to make projections of future needs for inclusion in the annual budget request. Productivity improvement was inherent in the use of the various systems but specific goals were seldom

published. The Federal sector had also developed more rigid standards and, once established, tended to adhere to them closely.

C. SUMMARY

This Chapter discussed the major features of a purchasing productivity measurement system. The researchers found that the most important elements of any measurement system are management commitment and proper task identification. Other essential elements such as developing standards, collecting data and weighting techniques were discussed with information from the various sites contacted used to illustrate relative strengths and weaknesses. The following Chapter will apply the factors presented in this section for developing a model for purchasing productivity measurement.

VI. GENERALIZED PURCHASING PRODUCTIVITY MODEL

A. PRESENTATION

The previous Chapter addressed the characteristics, parameters and factors that the researchers considered important in the development of a purchasing productivity model. This information was based on a review of a wide range of productivity measurement systems, productivity measurement related problems and opinions from a broad spectrum of purchasing personnel. Based on this research, it was evident that there was a need for the establishment of a generalized model that could be tailored to a purchasing organization that did not employ a productivity system or felt their present system inadequate. The model depicted in Figure 1 is the culmination of the researchers' efforts. This model, developed independently, reconfirms two existing similar models

PURCHASING PRODUCTIVITY MEASUREMENT MODEL

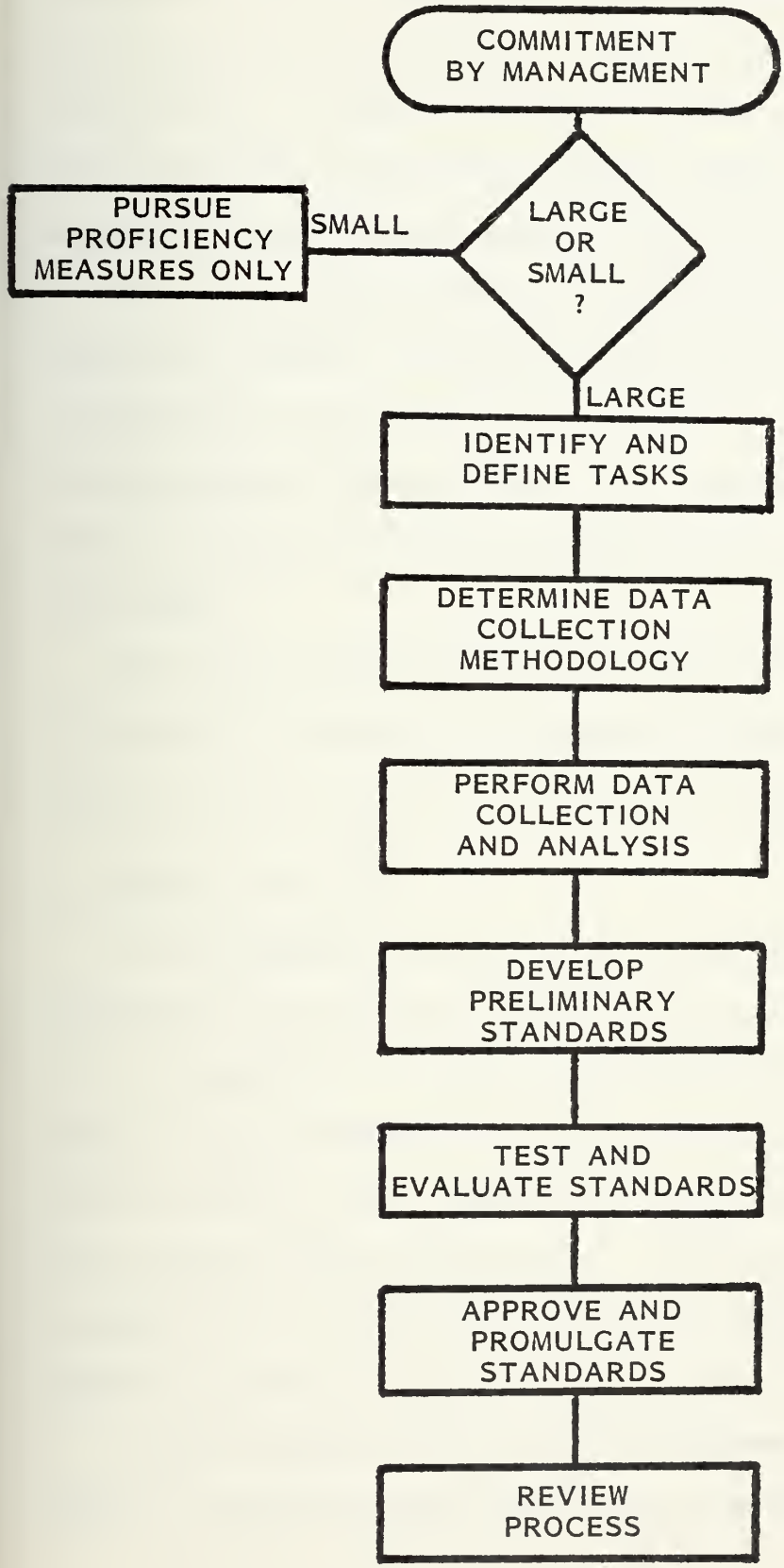

Figure 1

developed by the Air Force Staff College and the Navy's Shore Requirements, Standards and Manpower Planning Systems (SHORSTAMPS) [18:13, 38:6]. In addition, recent Government Accounting Office (GAO) reports conducted concurrently with this research but just recently published, also confirm the elements of the model [24].

The methodology in itself will not generate a successful productivity measurement system. A successful system will depend on the tailoring and application of the model to the needs of the organization. To illustrate application considerations, the researchers will apply the model to a public sector field purchasing office in the third section of this Chapter.

The second section will provide an analysis of the model and some of the specific parameters the researchers consider important in tailoring a purchasing productivity measurement system.

B. MODEL ANALYSIS

A firm management commitment is a mandatory ingredient before undertaking any productivity measurement program. Initial efforts are apt to be especially trying and require perseverance and dedication on behalf of senior management to motivate those involved with the system. Mere lip service or token support are quickly detected at lower management levels and among the workforce. This lack of commitment will be manifested in "just another unsuccessful management attempt" to establish a productivity performance measurement system.

In some situations, for the reasons discussed in the previous Chapter, productivity measurement may not be warranted. Typically

this is a function of the size of the office. Based on the research, it was determined that purchasing organizations employing less than 35 personnel and/or less than ten buyers (35/10) could just as effectively measure purchasing performance and output utilizing other management techniques and proficiency measures rather than true work measurement systems. A study performed at Michigan State University under a National Science Foundation grant offers performance measurement criteria that can be considered as an alternative to employing efficiency and productivity oriented systems [12]. The 35/10 cutoff is not meant to be an absolute level determinant, but rather, a general level below which productivity measurement systems might not be appropriate. Also, this is not an endorsement to ignore productivity in small offices; only that other considerations may be more effective and negate the cost and effort of maintaining and monitoring input-output.

For purchasing organizations in which a work measurement approach is appropriate, a methodology to achieve that end must start with an accurate statement of the output. This has been found to be critical to the development of the system and second only to management commitment as the most essential element. Re-emphasizing a point raised in Chapter V, worker involvement is important in identifying the output. Once identified, output definition statements are developed such that everyone is in agreement on what steps are involved regardless of who performs the task or monitors the output. An accurate statement of output minimizes the potential for manipulation and co-mingling of work. The number of tasks defined is a function of the organization's need to monitor output. Output for each activity must be tailored and

developed according to the functions and needs of each purchasing activity.

Once the tasks have been identified and defined, it is important to determine the input-output data collection methodology. Although the determinants and considerations of the data collection step have been discussed in more detail in Chapter V, it must be re-emphasized that data collection should: (1) minimize adding to the administrative clerical workload, and (2) take maximum advantage of existing data bases and reports.

Weighting is a key consideration that must be entertained at this time. Some weighting techniques can eliminate the need for individual recordkeeping and preclude some data collection problems by: (1) minimizing data manipulation, (2) elimination of employees' accounting for time performed on various functions, and (3) not adding to the individual purchasing personnel's administrative workload. Therefore, the data collection methodology should give some consideration to incorporating some form of weighting of work units such that input data can be collected without regard to establishing elaborate recording systems of time spent on each task identified.

Data collection is a critical element of the model since it will form the basis of future productivity measurement criteria. It must be done in accordance with the methodology established and contribute to the development of preliminary standards or weighting factors. There is some disagreement as to the length of time during which these data should be collected. The researchers have found that periods less than three months do not permit adequate accumulation of information

upon which to base projections while longer periods tend to draw out and only reconfirm what was developed after three months of tracking. Therefore, the researchers recommend establishing preliminary work standard targets after three months.

These preliminary standards are nothing more than targets. They should be tracked through the next phase for conformance and adjustment as necessary. Here also, the researchers consider that three months is required to adjust and smooth the preliminary target standards into standards that will be used to measure and evaluate future performance. Management must be alert to overreaction to out-of-line preliminary standards during this phase and ensure that all personnel involved are aware that the preliminary standards are subject to modification as justified or warranted. However, once established and approved, the standards will be used to allocate resources, measure activity and group performance, and assist management in controlling performance.

Once the standards have been established and approved, it is important to apply a review process. The review process is comprised of two aspects: (1) routine re-evaluation of the standards for accuracy and completeness, and (2) re-evaluation as a result of a change in the definition of a work unit or task.

The following section of this Chapter will develop and tailor a productivity measurement system for a public sector field activity.

C. APPLICATION OF THE MODEL

To demonstrate application of the model, the researchers selected a public sector field activity that agreed to support the study and

research efforts. The activity employs 30 personnel in the Contracting Division with 14 non-supervisory contract administrators and purchasing agents. The Division is comprised of three branches; the Contracts Branch which is responsible for procurements in excess of $10,000, the Purchasing Branch which is responsible for purchases less than $10,000, and the Contracting Support Branch. The Division is also supported by legal counsel and appropriate secretarial staff, and is responsible for about 11,238 annual procurement actions at a total value of $44 million. A wide range of commodities are purchased utilizing various contractual instruments with no single element dominating.

The existing productivity measurement system currently measures only small purchase actions (less than $10,000) accomplished in the Purchasing Branch. The system utilizes a single work unit consisting of all methods of small purchase such as Blanket Purchase Agreement (BPA) calls, imprest fund, telephone solicitations and purchase orders less than $10,000. Hours expended are applied against output to establish an output rate per buyer. The buyer is then compared against the work group norm. It does not recognize variances in workload composition and is subject to inefficiencies as a result of group norm rate setting. The system is a typical performance measurement program frequently found in other activities of this public sector agency.

After reviewing the system, the researchers found that it may be more beneficial to expand the number of work units for small purchase actions as well as establish a large purchase measurement system.

In accordance with the model, the first step in developing a productivity measurement system is to determine if there is a firm management

commitment. The answer in this case analysis was a resounding yes. The Division Director has been extremely helpful and supportive of the research effort and is keenly interested in improving the Contracting Division's overall efficiency.

The Division employs less than 35 personnel (actually 30); however, it does employ greater than ten buyers (actually 14), thereby meeting the range criteria where productivity measurement systems are considered appropriate. Therefore, a productivity measurement program will be developed.

In the interest of expediency and illustrative application of this model, certain process liberties must be taken. However, where possible, the model will be followed as closely as possible. For example, the researchers advocate worker involvement in identifying, developing, and defining work output and units to be measured; however, due to travel limitations, inaccessibility and time constraints, this could not be done.

Task identification and definitions were extracted from data provided by the Division Director. In identifying these tasks, the researchers maximized utilization of existing data bases and reports and minimized the potential disruption on worker processes. Work unit definitions were also influenced by Government regulations which create natural work unit divisions for purchase actions over and under $10,000 and the split in the organizational structure which divides large purchase actions (greater than $10,000) and small purchase actions (less than $10,000) between the two branches, the Contracting Branch and the Purchasing Branch respectively.

Work units for the large purchase branch were identified as: (1) negotiated awards greater than $100,000; (2) negotiated awards less than $100,000; (3) formally advertised awards greater than $100,000; and (4) formally advertised awards less than $100,000. Three work units were identified for the small purchase branch: (1) purchase orders less than $500; (2) purchase orders greater than $500; and (3) calls placed against BPA's.

Again, these work units were selected in the absence of worker involvement; however, care was exercised to take into consideration the preponderance of purchase actions, Government regulatory divisions, and existing work patterns. Detailed work unit definitions are provided in Appendix B.

The next step of the model is to determine the data collection methodology. Since this organization does not accumulate input man-hours separately by output and each buyer spends time on various work units, either a system of weighting or individual worker time recording must be established. The researchers selected a weighting system similar to the one discussed in Chapter V and employed at Company C. For illustrative purposes, utilizing dummy data, Appendix C provides a more detailed step-by-step process that can be followed in the development of this model and the weighting factor methodology. The Division, employing the methodology illustrated in Appendix C, can develop their own weighting factors for both large and small work units based on actual data.

Using this concept, the Division can use existing reports and tracking systems to gather man-hour input per buyer and Branch, and

work unit output. For example, this activity submits monthly reports to its Headquarters Command summarizing contract actions by various contract types and categories and accumulates buyer time from time cards. Thus no new additional requirements or reports will be necessary.

The three month period for collection of data should be utilized to: (1) establish average processing times per work unit based on a combination of direct observation, employee comments and inputs, and actual performance data; (2) establish weighting factors from the ratios of average processing times developed in (1) above; and (3) determine preliminary target standards based on weighted work unit (WWU) output and actual man-hours expended. These preliminary target standards should be implemented and tracked over the next three month re-evaluation period. During this time, the Division must be alert to isolate average times or weighting factors that are out of line and make adjustments to the WWU standards as warranted. Once re-evaluation has been completed and the Division Director feels comfortable with the standards, full implementation should commence immediately.

The system established will require more intense management during the initial phase of operation until the Division is familiar with its operation and gain confidence in its use. As time progresses, minor adjustments and modifications can be made to further refine the system to meet the Division's needs.

The final phase of the model is in the hands of the user. The usefulness and benefits derived from the system will be dependent on the efforts that contributed to the development and subsequent management commitment to its use.

This system developed will enable management to monitor employee performance as well as measure branch improvements. It can also be used to forecast resource requirements by applying projected workloads against the weighting factors to determine the corresponding number of WWU and personnel required to complete the projected workloads. Finally, the Director can use it as a management tool to keep a pulse on the operation and highlight potential deficient areas.

D. SUMMARY

This Chapter presented a model methodology that can be utilized to tailor a productivity measurement system to meet the needs of any purchasing organization. To further amplify the model, a public sector field purchasing office was subjected to the tailoring process. Development of actual standards and weighting factors were left to the activity utilizing the steps outlined in Appendix C and the accumulation of actual data under the new work units defined.

VII. CONCLUSIONS AND RECOMMENDATIONS

A. SUMMARY

Interest in productivity has risen as the nation's productivity growth continues to decline. Both Industry and Government are looking for ways to stretch their resources as their purchasing power shrinks in the face of double digit inflation. One way to stretch their limited funds is to increase the productivity of their organizations.

To improve productivity, a system must first be developed to measure it. This research has focused on the measurement of productivity

in a purchasing organization. The research was accomplished by: (1) reviewing the current literature base to gain familiarity and understanding of prevailing methods; (2) field research of 19 Government and ten Industry purchasing activities to determine present state-of-the-art purchasing productivity systems and initiatives; and (3) surveying key purchasing personnel to gain understanding of their perceptions and experience with productivity measurement. The purpose of the research was to develop an effective method of measuring the productivity of a purchasing organization that could provide the purchasing manager with the means to: (1) assess the performance of his organization, (2) distribute personnel, and (3) forecast workload requirements.

The biggest obstacle the researchers encountered was attempting to factor out the differences that existed between one activity and another. For example, each organization had defined small purchases differently, using various thresholds to signify the transition from small to large purchase. This made comparisons between activities more difficult.

As a result of the research, a model depicting the methodology for implementing a purchasing productivity measurement system was developed. Additionally, some conclusions have been reached regarding purchasing performance measurement. They are noted below followed by recommendations designed to assist in the implementation and evaluation of a purchasing productivity measurement system.

B. CONCLUSIONS

This research effort has led to several conclusions regarding the development and implementation of purchasing productivity measurement systems.

Conclusion 1. Properly designed and implemented, purchasing productivity measurement systems are effective in controlling purchase operations, projecting personnel needs, preparation of budgets and improving productivity. Performance data generated through a performance measurement system is useful to all levels of management. It removes much of the subjectivity from performance appraisal and justification of assets, adding credibility to actions taken by management. By focusing attention on improvement, those activities that have effective performance systems have often experiences documented increases in the productivity of their work groups.

Conclusion 2. No one best method of measuring purchasing performance presently exists in either Government or Industry. Differences exist in structure, type of purchases and method of procurement in an organization that make each unique. The various systems studied have illustrated that many of the performance measurement systems in use are developed to recognize these differences and to meet the needs of an individual organization. Attempts to impose one measurement system on a variety of organizations without considering these differences has often resulted in inaccurate comparisons and misleading indications of the productivity of individual organizations in the system.

Conclusion 3. Rather than expending efforts in measuring efficiency, small purchase organizations should concentrate on improving the proficiency of their buying operations. Measuring the efficiency of a small purchase organization does not enhance performance. The manager of this type of

organization has frequent contact with each buyer and knows how efficient an individual or group is performing. The type of information that is generated as a result of measuring efficiency would not alter the management style or method of internal budgeting that is presently employed in activities with small purchasing organizations.

Conclusion 4. A lack of management commitment is the primary reason that numerous activities are not achieving the desired results from their purchasing productivity measurement systems. Many activities contacted had performance measurement systems but there was no requirement or incentive to use the system in the evaluation of efficiency or the justification of resources. A lack of management commitment is evident when (1) no visible support is given to the system, (2) performance is relegated to a low priority in the organization, (3) the information generated through the system is not used in decision-making, and (4) no rewards are offered to workers and supervisors for superior performance. If any of the above conditions exist, then the system will not reach its full potential.

Conclusion 5. Management has not exercised sufficient control over the accuracy and validity of the tasks being measured and the standards being promulgated. When the tasks being measured do not represent the work being performed or the standards are unrealistic, then the system will not be supported by those who are being monitored. Accuracy is lost when management fails to properly define tasks and promulgate realistic standards in the initial stages of development of a performance measurement system. Accuracy is also lost when management fails to make the necessary adjustment as changes occur in the nature of the

work and contracting methodology. Once the performance measurement system loses its validity, it is of little use to management.

Conclusion 6. The purchasing performance measurement systems that are presently implemented in Government and Industry are not being fully utilized. A performance measurement system can be used for a variety of management purposes. Examples previously cited include: (1) evaluation of performance, (2) developing budgets, (3) assigning resources and (4) improving productivity. Organizations frequently use their systems in some of these areas but rarely apply the system to all of them. This was often due to a lack of confidence in the system or management confining their interest to one specific area. Management forfeits many benefits by not using a measurement system to its full potential.

C. RECOMMENDATIONS

Recommendation 1. Purchasing managers should utilize the model described in Chapter VI to establish a purchasing productivity measurement system or to evaluate an existing system. Many of the systems described in previous Chapters were unsuccessful because they lacked one or more of the essential characteristics required to have an effective performance measurement system. The recommended model can be used at all levels of an organization and recognizes that differences exist between each organization and that any system must be tailored for each activity. The recommended model illustrates the steps for developing and implementing a performance measurement system from management commitment to task definition and finally to the promulgation of standards.

Neglecting any of the steps would severely impair the utilization of the system.

Recommendation 2. Once a method of measuring purchasing performance has been established, management should use and support the system long enough to gain the benefits of the system. The implementation of a performance measurement system will not by itself guarantee an immediate improvement in productivity. The benefits of performance measurement occur after the system has been used over a period of time where trends can be examined and standards refined. This allows management to use the data to concentrate on methods of improving productivity rather than just measuring it. Frequent changes in the method of measuring performance only confuse and frustrate those that must use the system and each succeeding attempt will be met with increasing resistance.

Recommendation 3. The personnel that actually perform the tasks should be involved in the development of the purchasing productivity measurement system. Accurately defined tasks and realistic standards cannot be over-emphasized. The best qualified personnel in an organization to determine what should be measured are the workers themselves. The same is true when standards are being developed. The activities that have had worker involvement in the development of the measurement system have experienced better task definition and the added benefit of the support of the workers in measuring performance.

Recommendation 4. Purchasing managers should keep the performance measurement system as simple as possible. Several of the activities had installed systems that were unnecessarily complex and not particularly

cost effective. Any system that adds to the clerical work of the buyers or requires substantial capital resources should be carefully examined. The needs of an activity will determine the type of system to be established. These needs are influenced by the type of organization, its size, and complexity of purchases made.

D. REVIEW OF RESEARCH QUESTIONS

In order to respond to the research question, three subsidiary questions were posed. Responses can now be summarized beginning with the subsidiary questions and culminating with the principal research question.

Subsidiary Question 1. What are the significant outputs of a purchasing organization? Chapters III and IV addressed some of the productivity measurement systems employed in the public and private sectors and their corresponding outputs. It was observed that the purchasing tasks performed at each activity varied significantly as a result of: (1) the types of commodities purchased, (2) the contracting methodologies employed, (3) the complexities of the procurement instrument and (4) the degree and extent of contract administration performed. In order to accurately measure output, each activity must define its own output so that the work being measured actually reflects the work being performed.

Subsidiary Question 2. Can a single purchasing productivity measurement system be applied to all purchasing organizations? The research indicated that no predominant method of measuring purchasing productivity existed. However, the better methods recognized the

varying degrees of complexity of purchasing functions and the organizational peculiarities that make a single system impractical. Chapters V and VI discussed those factors that must be considered in developing a productivity measurement system.

Subsidiary Question #. What are the benefits that can be derived from measuring purchasing productivity? Chapters III and IV illustrated the benefits that can be derived from measuring purchasing productivity. These benefits can be classified in four general categories: (1) increased management control of the purchasing activity, (2) better allocation and distribution of resources, (3) improved budget formulation based on workload and manpower projections, and (4) improved productivity.

Research Question. What are the critical parameters to be considered in the development of a purchasing productivity model? Although no one best method was uncovered in this research, certain common elements were determined to be critical to the success of any purchasing productivity measurement system. Chapter V discussed these parameters and Chapter VI developed a model based on these parameters. The most significant of these are: (1) management commitment, (2) proper identification and definition of tasks, (3) development and promulgation of realistic standards, and (4) employee involvement in the identification of tasks and the establishment of standards.

E. AREAS OF FURTHER RESEARCH

Due to the magnitude and complexity of purchasing functions, the researchers excluded contract administration and major system acquisition from the area of the study. These two aspects of purchasing offer

different and unique problems. The researchers, however, found no evidence to conclude that productivity measurement cannot also be pursued in these two areas. Therefore, it is recommended that further research into studying productivity measurement of contract administration functions as well as major systems acquisition be pursued.

APPENDIX A

INTERVIEWEE SURVEY RESULTS:

SYNOPSIS

Forty-two key personnel familiar with purchasing functions were interviewed during the course of the research. The following synopsis is provided:

1. Fifty-two percent of the activities contacted employed a productivity measurement system. Productivity measurement systems were more predominant in the public sector by a 58% to 40% margin. The researchers attribute this to the greater emphasis on productivity measurement systems in the interest of public trust and the effective utilization of public resources.
2. Sixty-one percent of the individuals working in an organization employing a productivity measurement system consider it to be ineffective. The private sector respondents were somewhat more pleased with their systems than their public sector counterparts by 17%. The researchers believe most of the public sector's dissatisfaction stems from experience with productivity measurement systems which result in ineffective comparisons by higher level management and the subsequent misallocation of resources and misinterpretation of results.
3. Seventy-one percent of all respondents believe purchasing functions can be measured with slightly less, 64%, believing that standards can be developed. There was no appreciable difference in opinions on the issue of standards between public

and private sector; however, the private sector, by an 81% to 65% margin have a stronger belief that purchasing functions can be measured. The researchers believe the higher level of private sector confidence in the ability to measure purchasing functions is directly related to the corresponding higher level (by 17%) of confidence the private sector respondents had in the systems they employed as just discussed in number 2 above.

4. The issue of comparison appears to be best suited to comparing similar work groups with 76% of the respondents indicating that similar work groups could be compared. A fewer number (57%) also believed comparisons could be made between individuals within an organization; while only 35% considered activity to activity comparisons to be realistic. There was no significant variance between public and private sector opinions on the first two comparisons; however, the public sector by a 46% to 19% margin believed activity-to-activity comparisons are reasonable. The researchers attribute this to the public sector's greater need and mandate for agencies to compare field activities and allocate resources as necessary and the private sector's company-to-company independence.

5. Twenty-one percent answered "no" to the hypothetical question, "If an effective productivity measurement system could be designed, would you use it?". This question was considered to be at the basis of underlying attitudes toward the productivity issue. It was considered that the two extremes could be polarized to isolate those individuals that firmly believe productivity

measurement to be a waste of time. The negative responses between the two sectors was remarkably different.

In the private sector, 75% of the negative responses came from small purchase activities. These smaller offices believe that there is a greater payback from proficiency measures such as cost reductions and savings than efficiency improvements. Further, that smaller work groups are more conducive to monitoring each employee by direct observation and a "gut feel" for efficiency measurement.

The public sector's small purchasing activities indicated a strong willingness to employ a productivity measurement system if one could be developed. The preponderance of the negative responses, instead, came from lower level managers who the researchers believe have a greater degree of skepticism, doubt and mistrust of productivity measurement systems.

INTERVIEWEE SURVEY RESULTS

ORGANIZATION CHARACTERISTICS							OPINIONS							
									J			K		
A	B	C	D	E	F	G	H	I	1	2	3	1	2	3
1	X			X	N		N	N	Y	Y	N	Y	Y	
2	X		X		Y	Y	Y	Y	Y	Y	N	Y	Y	
3	X		X		Y	Y	Y	O	Y	Y	Y	Y	Y	
4	X		X		Y	N	N	N	N	N	N			X
5	X			X	N		Y	O	Y	Y	Y	Y	Y	
6	X		X		Y	N	Y	Y	N	Y	Y	Y	Y	
7	X		X		N		N	N	N	N	N	Y	Y	
8	X			X	Y	Y	Y	Y	N	Y	N	Y	Y	
9	X		X		Y	N	N	N	N	N	N			X
10	X		X		Y	N	N	N	N	Y	N			X
11	X		X		Y	N	N	N	N	N	N			X
12	X			X	N		Y	Y	Y	Y	Y	Y	Y	
13	X		X		Y	N	N	N	N	N	N	Y	Y	
14	X		X		N		Y	Y	Y	Y	Y	Y	Y	
15	X		X		N		N	N	N	N	N			X
16	X		X		Y	Y	Y	Y	Y	Y	Y	Y	Y	
17	X		X		Y	Y	Y	Y	N	Y	N	Y	Y	
18	X		X		Y	Y	Y	Y	Y	Y	N	Y	Y	
19	X		X		N		Y	Y	Y	Y	Y	Y	Y	
20	X		X		Y	N	Y	Y	Y	Y	N	Y	Y	
21	X		X		Y	N	Y	Y	Y	Y	Y	Y	Y	
22	X		X		Y	N	N	N	Y	N	N	Y	Y	
23	X		X		Y	N	Y	Y	Y	Y	Y	Y	Y	
24	X		X		Y	N	Y	Y	Y	Y	Y	Y	Y	
25	X		X		O	O	Y	Y	O	Y	Y	Y	Y	
26	X		X		Y	N	Y	Y	Y	Y	Y	Y	Y	
T	26		22	4	18Y 7N	6Y 12N	17Y 9N	15Y 9N	15Y 10N	19Y 7N	12Y 14N	21	21	5

COLUMN HEADINGS

A Respondent
B Public sector
C Private sector
D Large activity
E Small activity
F Is a system currently in use?
G Is the system effective?

H Can purchasing functions be measured?
I Can standards be developed?
J Can comparisons be made?
  1 between individuals?
  2 between groups?
  3 between activities?
H If a system could be designed would you use it?
  1 to allocate resources?
  2 as a management tool?
  3 would not use it.

INTERVIEWEE SURVEY RESULTS

ORGANIZATION CHARACTERISTICS							OPINIONS							
									J			K		
A	B	C	D	E	F	G	H	I	1	2	3	1	2	3
1		X		X	N		N	N	N	N	N			X
2		X	X		Y	Y	Y	Y	N	Y	N	Y	Y	
3		X		X	N		N	N	Y	Y	Y			X
4		X		X	N		Y	Y	Y	Y	Y	Y	Y	
5		X	X		Y	N	Y	Y	Y	Y	N	Y	Y	
6		X	X		Y	N	Y	Y	Y	Y	N	Y	Y	
7		X	X		N		Y	N	Y	Y	Y			X
8		X	X		N		Y	Y	Y	Y	N	Y	Y	
9		X	X		Y	N	Y	Y	Y	Y	N	Y	Y	
10		X	X		Y	N	Y	Y	Y	Y	N	Y	Y	
11		X	X		N		N	N	N	N	N	Y	Y	
12		X	X		N		Y	O	O	O	N	Y	Y	
13		X	X		Y	Y	Y	Y	N	Y	N	Y	Y	
14		X	X		Y	Y	Y	Y	N	Y	N	Y	Y	
15		X	X		Y	Y	Y	Y	N	Y	N	Y	Y	
16		X		X	N		Y	N	Y	N	N	Y	Y	X
T		16	12	4	8Y 8N	4Y 4N	13Y 3N	10Y 5N	9Y 6N	12Y 3N	3Y 13N	12	12	4
GT	26	16	34	8	26Y 15N	10Y 16N	30Y 12N	25Y 14N	24Y 16N	31Y 10N	15Y 27N	33	33	9

Y - Yes, N - No, O - NO Opinion, T - Total
GT - Grand Total

COLUMN HEADINGS

A Respondent
B Public sector
C Private sector
D Large activity
E Small activity
F Is a system currently in use?
G Is the system effective?

H Can purchasing functions be measured?
I Can standards be developed?
J Can comparisons be made?
  1 between individuals?
  2 between groups?
  3 between activities?
H If a system could be designed would you use it?
  1 to allocate resources?
  2 as a management tool?
  3 would not use it.

APPENDIX B

ANALYSIS OF A PUBLIC SECTOR PURCHASING ACTIVITY:

WORK UNIT DEFINITIONS

LARGE PURCHASE

1. Negotiated awards greater than $100,000. Includes all negotiated awards greater than $100,000 regardless of contract type. Work unit includes time spent on pre-solicitation actions, preparation of the RFP, pre-award surveys, cost and price analysis, profit analysis, negotiations and awards.

   Point of Count. Contracts awarded.

   Reason for work unit. Comprises 21% of the large purchase actions. Differs significantly from contracts less than $100,000 due to Government regulations such as Public Law 87-653 requirements. Differs from formally advertised awards in the method of award phase significantly to warrant separate work units.

2. Formally advertised awards greater than $100,000. Includes all formally advertised awards greater than $100,000. Work unit includes time spent on pre-solicitation actions, preparation of the IFB, pre-award surveys, evaluation of bids, and contract award.

   Point of Count. Contracts awarded.

   Reason for work unit. Represents a significant amount of the large purchase actions. Differs significantly from contracts less than $100,000 due to Government regulations such as Public Law 87-653 requirements. Also differs significantly in the actions required from negotiated contracts.

3. Negotiated awards less than $100,000. Includes all negotiated contracts less than $100,000 but more than $10,000. Consists of all contract actions from pre-solicitation to final award.

Point of Count. Contracts awarded.

Reason for work unit. Comprises 37% of the large purchase actions. Method of award and procedures differs significantly from formally advertised awards and contracts greater than $100,000 and less than $10,000.

4. Formally advertised awards less than $100,000. Includes all formally advertised awards less than $100,000 but more than $10,000. Consists of all contract actions to award.

Point of Count. Contracts awarded.

Reason for work unit. Comprises 34% of the large purchase actions. Method of award and procedures differs significantly from negotiated contracts and contracts greater than $100,000 and less than $10,000.

SMALL PURCHASE

1. Purchase orders greater than $500 but less than $10,000. Includes any contract action between $500 and $10,000 regardless of contract instrument, method of award or source selection criteria. This work unit also includes orders awarded against a Basic Ordering Agreement and other miscellaneous actions between $500 and $10,000. Excluded from this tasking is contract administration and other post award functions.

Point of Count. Awards placed.

Reason for work unit. Comprises 26% of all small purchase actions. The steps for most of the actions under this work unit are typically homogeneous and significantly different from the other defined work units. Data for this work unit is presently being accumulated.

2. Purchase orders less than $500. Primarily involves telephone solicitations, written solicitations, imprest fund procurements and other miscellaneous purchase actions less than $500 not expressly covered by another work unit. Typically for commercial off the shelf type items.

   Point of Count. Line items procured.

   Reason for work unit. Comprises 29% of all small purchase actions. Relatively homogeneous in complexity and time involved to complete and significantly different from the other work units. Data presently accumulated for this work unit.

3. Blanket Purchase Agreement (BPA) calls. Includes all calls placed against an existing BPA regardless of dollar value. Does not include negotiation or establishment of the BPA itself.

   Point of Count. Orders placed.

   Reason for work unit. Comprises 45% of all small purchase actions. Relatively homogeneous task and time requirements significantly different from other units. Data presently accumulated for this work unit.

APPENDIX C

ANALYSIS OF A PUBLIC SECTOR PURCHASING ACTIVITY: STEP-BY-STEP ILLUSTRATIVE PROCESS

STEP	APPLICATION
1. Identify work units and define.	Seven work units have been identified, four for large purchase and three for small purchase type actions. The large purchase actions are totally processed in the Contracting Branch while the small purchase actions are processed in the Purchasing Branch. These two branches are divided by grade level of employee such that each branch is somewhat homogeneous within the branch but significantly different in make-up from each other. Therefore, the work units defined are: Large Purchase - 1. Negotiated awards greater than $100,000. 2. Formally advertised awards greater than $100,000. 3. Negotiated awards less than $100,000.

4. Formally advertised awards less than $100,000.

Small Purchase -

1. Purchase orders greater than $500.
2. Purchase orders less than $500.
3. Calls placed against a Blanket Purchase Agreement (BPA).

2. Determine average time to perform each work unit.

These times were arbitrarily assigned for analysis purposes. Actual times must be established by the division during the three month data collection phase from: (1) actual data collected; (2) time and motion studies of the work units performed by the Division; and (3) negotiation between management and employees.

Average times established for the work units in this analysis:

Large purchase -

1. .05 items/hr. (20.0 hrs./item)
2. .07 items/hr. (14.3 hrs./item)
3. .11 items/hr. (9.1 hrs./item)
4. .13 items/hr. (7.7 hrs./item)

Small purchase -

1. .50 items/hr. (2.0 hrs./item)
2. 2.5 items/hr. (14 hrs./item)
3. 4.0 items/hr. (.25 hrs./item)

3. Establish weighting factors by taking the ratio of time for each work unit to the time required to perform the longest work unit.

At this point, two approaches were considered. Weighting can be done by weighting all seven work units for the Division as a whole or weight the large and small work units separately within the category of large and small purchase for each Branch. Since this Activity is cleanly divided into the two branches and desires a work measurement system for internal use only and not for comparative analysis by higher agency headquarters, weighting will be established separately for large and small purchase actions.

Weights were established as follows:

Large purchase -

1. 1.0 (20 ÷ 20)
2. .715 (14.3 ÷ 20)
3. .455 (9.1 ÷ 20)
4. .385 (7.7 ÷ 20)

Small purchase -

1. 1.0 (2 ÷ 2)

2. .2 (.4 ÷ 2)

3. .125 (.25 ÷ 2)

If a single system was desired, the seven work units would be considered as follows:

1. 1.0 (20 ÷ 20)

2. .715 (14.3 ÷ 20)

3. .455 (9.1 ÷ 20)

4. .385 (7.7 ÷ 20)

5. .1 (2 ÷ 20)

6. .02 (.4 ÷ 20)

7. .013 (.25 ÷ 20)

4. Measure and record output per buyer and work center according to the work units defined.

During the three month data collection phase work units completed should be accumulated for each evaluation period (i.e., monthly, bi-weekly, weekly). The Division can extract work counts from existing reporting systems.

5. Establish Weighted Work Units (WWU) by multiplying output times the weighting factor.

This should be done for each evaluation period to establish trends and to accumulate a historical data base.

For the purpose of this illustrative analysis, example calculations for a one week evaluation period can be found in this Appendix.

6.	Record the actual hours worked and establish production rates for each buyer and work center.	Actual hours for the Division can be extracted from existing payroll reporting systems. Production rates achieved are computed from output for the evaluation and actual hours expended during the same reporting period. Example calculations are provided later in this Appendix.
7.	Establish preliminary standards.	Accumulate data for three months. Establish baseline production standards utilizing the historical data accumulated tempered with human judgement and first level supervisor input. Any form of statistical analysis, such as regression analysis, may be employed to establish these preliminary target standards.
8.	Test and evaluate preliminary target standards.	Evaluate the preliminary standards under live conditions for three months. Performance of the individual and work center should be monitored. Isolate, adjust and revise average processing times, weighting factors or standards as necessary.
9.	Promulgate definitive standards.	

EXAMPLE CALCULATIONS

(SMALL PURCHASE FUNCTIONS ONLY)

Work units [1]	P.O. > $500	P.O. < $500	BPA calls			
Average time [2]	2 hrs/item	.4 hrs/item	.25 hrs/item			
Weighting factors [3]	1.0	.2	.125	WWU [5]	Actual [6] Hrs	Rate
Buyer 1	16 [4]	0	10	17.25	40	.43
Buyer 2	6	25	40	16.0	36	.44
Buyer 3	14	17	0	17.4	40	.44
Buyer 4	15	5	0	16.0	40	.40
Buyer 5	1	50	55	17.88	40	.45
Buyer 6	14	4	12	16.3	40	.41
Work Center	66	101	117	100.83	236	.43

Superscript numbers correspond to step number.

APPENDIX D

INTERVIEWEES

1. Alldredge, R. W.
   Materials Department Staff
   Boeing Airospace Company
   Seattle, Washington
   5 August, 1980

2. Allshouse, T. J., RADM, SC, USN
   Commanding Officer
   Navy Ships Parts Control Center
   Mechanicsburg, Pennsylvania
   13 June, 1980

3. Autry, L. M.
   Manager Financial Analysis
   Douglas Aircraft Company
   Lakewood, California
   6 June, 1980

4. Babisch, J.
   Chief of Procurement
   State of California
   Sacramento, California
   17 July, 1980

5. Bringuel, R. P.
   Manager Material Department
   Radar Systems Group Manufacturing Division
   Hughes Aircraft Company
   El Segundo, California
   4 June, 1980

6. Brown, W.
   Staff to Purchase Division
   State of Oregon
   Salem, Oregon
   15 August, 1980

7. Chism, D. M., CDR, SC, USN
   Director, Contracting Department
   Naval Supply Center
   Oakland, California
   11 April, 1980

8. Crognale, S. J., LCDR, SC, USN
   Staff to Purchase Division
   Navy Ships Parts Control Center
   Mechanicsburg, Pennsylvania
   13 June, 1980

9. Davis, G.
Director, Purchasing and Stores
County of Los Angeles
Los Angeles, California
13 August, 1980

10. Folkin, A.
Manager, Quick Response Team
Defense and Space Systems Group of TRW INC.
Redondo Beach, California
4 June, 1980

11. Fox, G. P.
Purchasing Manager
William H. Rorer, Inc.
Fort Washington, Pennsylvania
10 June, 1980

12. French, R. C., CAPT, SC, USN
Commander
Defense Contract Administration Management Area
San Francisco, California
25 April, 1980

13. Gould, J., MAJ, USAF
Staff
Headquarters Air Force Systems Command
Washington, D.C.
17 July, 1980

14. Hoffman, R. J.
Director of Purchasing
Defense Industrial Supply Center
Philadelphia, Pennsylvania
10 June, 1980

15. Holder, J.
Director of Contracts
Sun Shipbuilding INC.
Chester, Pennsylvania
2 June, 1980

16. Hubner, M.
Staff to Purchasing Division
Navy Ships Parts Control Center
Mechanicsburg, Pennsylvania
13 June, 1980

17. Hunter, C. S., LCDR, SC, USN
Staff to Contracts Division
Headquarters Naval Supply Systems Command
Washington, D.C.
12 June, 1980

18. Innes, A., MAJ, USAF
Director of Purchasing
Castle AFB
Merced, California
18 April, 1980

19. Isenberg, N.E.
Director of Purchasing
Gulf Oil
Philadelphia, Pennsylvania
10 June, 1980

20. Jacques, G.
Procurement Agent
County of Monterey
Salinas, California
8 April, 1980

21. Johnson, J.
Procurement Program Coordinator
Northrup Corporation
Hawthorne, California
5 June, 1980

22. Kosar, P. G., LT, SC, USN
Naval Postgraduate School
Monterey, California
20 March, 1980

23. Masterjohn, W.
Director of Materials (AWACS)
Boeing Airospace Company
Seattle, Washington
5 August, 1980

24. McClimans, S.
Head, Buying Branch 1
Navy Ships Parts Control Center
Mechanicsburg, Pennsylvania
13 June, 1980

25. McGilvray, M.
Material Director
Lockheed Missiles and Space Company, INC.
Sunnyvale, California
12 August, 1980

26. Rapp, C. J.
Manager, Material Research and Forecasting
Defense and Space Systems Group of TRW INC.
Redondo Beach, California
4 June, 1980

27. Rebo, J. D.
Branch Head
Defense Contract Administration Management Area
San Francisco, California
25 April, 1980

28. Robinson, W.
Staff
Defense Industrial Supply Center
Philadelphia, Pennsylvania
10 June, 1980

29. Rogers, R.
Director of Purchasing
County of Kane
Geneva, Illinois
14 August, 1980

30. Sager, C. P., LCDR, SC, USN
Staff to Purchasing Division
Aviation Supply Office
Philadelphia, Pennsylvania
10 June, 1980

31. Schrendeman, S.
Director of Purchasing
State of Washington
Olympia, Washington
13 August, 1980

32. Sheppard, R.
Production Manager
Hughes Aircraft Company
El Segundo, California
4 June, 1980

33. Stalford, S. D.
Outside Production Manager
Douglas Aircraft Company
Lakewood, California
6 June, 1980

34. Stemple, J.
Assistant Head, Buying Branch 2
Aviation Supply Office
Philadelphia, Pennsylvania
10 June, 1980

35. Thompson, G. J., RADM, SC, USN
Deputy Director (CAS)
Defense Logistics Agency
Cameron Station, Alexandria, Virginia
14 April, 1980

36. Toth, F. T.
Contracts Division Policy Staff
General Service Administration
Washington, D.C.
11 June, 1980

37. Tuvey, L.
Deputy Director, Contracting Department
Naval Supply Center
Oakland, California
11 April, 1980

38. Vitol, J. L.
Senior Consultant
Office of Consulting Services
Office of Personnel Management
Washington, D.C.
7 August, 1980

39. Weaver, D.
Director of Procurement Assessment
Department of Energy
Washington, D.C.
12 June, 1980

40. Williams, K.
Director of Material
Douglas Aircraft Company
Lakewood, California
6 June, 1980

41. Wilson, D.
Director of Purchasing
Todd Shipyards
San Pedro, California
5 June, 1980

42. Wrinkle, L.
Staff, Procurement Policy
Lockheed Missiles and Space Company, INC.
Sunnyvale, California
12 August, 1980

SELECTED BIBLIOGRAPHY

1. Anderson, J. C. and Shakman, R. J., "PMS Boosts Productivity and Morale", Defense Management Journal, v. 14, July 1978.

2. Arthur D. Little, Inc., Survey of Work Factors for the Planning of Research and Development Procurement Activities, 28 March 1975.

3. Carpenter, C. F., "Making Defense More Productive", Perspectives in Defense Management, Winter 1974-1975.

4. Encyclopaedia Britannica, Macropaedia, "Taylor, Frederick Winslow", v. 18, Encyclopaedia Britannica, Inc., 1977.

5. Greenberg, L., A Practical Guide to Productivity Measurement, Washington, D.C., Bureau of National Affairs, Inc., 1973.

6. Kendrick, J. W., Postwar Productivity Trends in the United States, 1948-1969, New York, Columbia University Press, 1973.

7. Kendrick, J. W., Understanding Productivity, An Introduction to the Dynamics of Productivity Change, Baltimore, John Hopkins University Press, 1977.

8. Kendrick, J. W. and Grossman, E. S., Productivity in the United States, Baltimore, John Hopkins University Press, 1980.

9. Kosar, P. G., Productivity in DOD Contracting Activities, paper presented at Naval Postgraduate School, Monterey, Ca., March 1980.

10. Lee, L. and Dobler, D. W., Purchasing and Materials Management, New York, McGraw-Hill Book Co., 1977.

11. McDermott, T. C., "The Human Dimension in Productivity, The Quality of Work Programs", Vital Speeches of the Day, v. 43, 1 March 1977.

12. Michigan State University, Purchasing Performance, Measurement and Control, by R. M. Monczka, P. L. Carter, J. H. Hoagland and L. W. Foster, August 1978.

13. Nassr, M. A., "Productivity Growth Through Work Measurement", Defense Management Journal, v. 13, 17 April 1977.

14. Poulos, P. G., "Challenging DOD Managers to Improve Internal Productivity", Defense Management Journal, v. 13, 17 April 1977.

15. Rees, A., "Improving the Concepts and Techniques of Productivity Measurement", Monthly Labor Review, v. 102, September 1979.

16. U.S. Air Force, AFLC Manual 70-345, Manpower Productivity and Projection System (E841), 3 March 1977.

17. U.S. Air Force, AFM Manual 26-3, Volume II, 1 January 1973.

18. U.S. Air Force, Air Command and Staff College, Contracting Productivity Measurement System, by L. A. Auffrey, Maxwell AFB, Alabama, April 1979.

19. U.S. Air Force, Air Force Logistics Management Center, Contracting Productivity Measurement at Base Level, by R. F. Hetherington, Gunter AFB, Alabama, March 1979.

20. U.S. Army, Army Material Development and Readiness Command, Measuring Productivity in DARCOM's Central Procurement Offices, by C. A. Correia and F. Kelsey, February 1978.

21. U.S. Army, Army Procurement Research Office, Logistics Management Center, Models to Forecast Workload of Central Procurement Offices in AMC's Major Subordinate Commands, by C. A. Correia, R. L. Launer, and S. H. Carter, Fort Lee, Va., October 1974.

22. U.S. Army, Army Procurement Research Office, Logistics Management Center, Forecasting Contract Administration Workload, by R. L. Launer, Fort Lee, Va., June 1975.

23. U.S. Army, Army Tank-Automotive Command, TACOM Central Procurement Activity Work Measurement Study, by D. A. Parobek, Warren, Mich., July 1975.

24. U.S. Comptroller General, Evaluating a Performance Measurement System - A Guide for the Congress and Federal Agencies, Washington, D.C., U.S. Government Printing Office, 12 May 1980.

25. U.S. Comptroller General, Improvements Needed in Defense's Effort to Use Work Measurement, Washington, D.C., U.S. Government Printing Office, 1976.

26. U.S. Comptroller General, Improving Federal Agency Efficiency Through the Use of Productivity Data in the Budget Process, Washington, D.C., U.S. Government Printing Office, 10 May 1978.

27. U.S. Comptroller General, Productivity Measurement in the Defense Logistics Agency Must be Supported, Improved and Used, Washington, D.C., U.S. Government Printing Office, 18 April 1980.

28. U.S. Comptroller General, The Federal Role in Improving Productivity - Is the National Center for Productivity and Quality of Working Life the Proper Mechanism?, Washington, D.C., U.S. Government Printing Office, 23 May 1978.

29. U.S. Congress, Senate, Committee on Government Operations, National Productivity and Quality of Working Life - 1975, Washington, D.C., U.S. Government Printing Office, March 1973.

30. U.S. Congress, Senate, Committee on Joint Economics, Productivity, Washington, D.C., U.S. Government Printing Office, June 1979.

31. U.S. Defense Logistics Agency, DSAH-CO Publication, Integrated Management Engineering System - Understanding Special Purpose Data, Cameron Station, Va., January 1977.

32. U.S. Department of Defense, DOD Instruction 5010.31, Productivity Program, Washington, D.C., U.S. Government Printing Office, April 1979.

33. U.S. Department of Defense, DOD Instruction 5010.34, Productivity Enhancement, Measurement, and Evaluation - Operating Guidelines and Reporting Instructions, Washington, D.C., U.S. Government Printing Office, 4 August 1975.

34. U.S. National Center for Productivity and Quality of Working Life, Improving Productivity Through Industry and Company Measurement, Washington, D.C., U.S. Government Printing Office, October 1976.

35. U.S. National Center for Productivity and Quality of Working Life, Productivity in the Changing World of the 1980's, Washington, D.C., U.S. Government Printing Office, 1978.

36. U.S. National Commission on Productivity, Productivity - Second Annual Report, Washington, D.C., U.S. Government Printing Office, March 1973.

37. U.S. National Commission on Productivity and Work Quality, Productivity - Fourth Annual Report, Washington, D.C., U.S. Government Printing Office, March 1975.

38. U.S. Navy, Shore Requirements, Standards and Manpower Planning System, Presentation at Naval Postgraduate School, Monterey, Ca., May 1978.

39. Wayne State University, Productivity Measurement System for State and Local Government Purchasing and Material Management Services, Volume I, by W. E. Burrell, F. E. Plonka and B. Pattee, Detroit, Mich., 1975.

40. Weil, F. A., "Management's Drag on Productivity", Business Week, 3 December 1979.

INITIAL DISTRIBUTION LIST

		No. Copies
1.	Defense Technical Information Center Cameron Station Alexandria, Virginia 22314	2
2.	Defense Logistics Studies Information Exchange U.S. Army Logistics Management Center Fort Lee, Virginia 23801	1
3.	Library, Code 0142 Naval Postgraduate School Monterey, California 93940	2
4.	Library, Code 55 Naval Postgraduate School Monterey, California 93940	1
5.	Dean of Research, Code 012 Naval Postgraduate School Monterey, California 93940	1
6.	CDR David Lamm, Code 54Lt Department of Administrative Sciences Naval Postgraduate School Monterey, California 93940	5
7.	Department Chairman, Code 54Js Department of Administrative Sciences Naval Postgraduate School Monterey, California 93940	1
8.	LT Patrick W. Cummings 4750 Oakmont St. Philadelphia, Pennsylvania 19136	3
9.	LCDR Dennis L. Wright Naval Supply Depot Yokosuka, Japan FPO Seattle, Washington 98762	3
10.	Mr. S. D. Stalford Douglas Aircraft Company Internal Mail Code 200-13 2500 E. Carson St. Lakewood, California 90712	1

11. Mr. Richard P. Bringuel — 1
Manager, Material Department
Radar Systems Group Manufacturing Division
Hughes Aircraft Company
El Segundo, California 90250

12. Mr. James L. Vitol — 1
Office of Consulting Services
U.S. Office of Personnel Management
1900 E. Street, N.W.
Washington, D.C. 20415

13. Mr. Wayne Masterjohn — 2
Boeing Airospace Company
P. O. Box 3999
Seattle, Washington 98124
Internal Mail Stop 20-94

14. RADM T. J. Allshouse, SC, USN — 1
Commanding Officer, Code 700
Navy Ships Parts Control Center
Mechanicsburg, Pennsylvania 17055

15. LCDR C. S. Hunter, SC, USN — 1
Code SUP
Naval Supply Systems Command
Department of the Navy
Washington, D.C. 20376

16. Mr. H. Johnson — 1
Northrup Corporation
Aircraft Group, Aircraft Division
39 West Broadway
Hawthorne, California 90250

17. Mr. M. McGilvray — 1
Lockheed Missile and Space Company, Inc.
Material Department
Sunnyvale, California 94086